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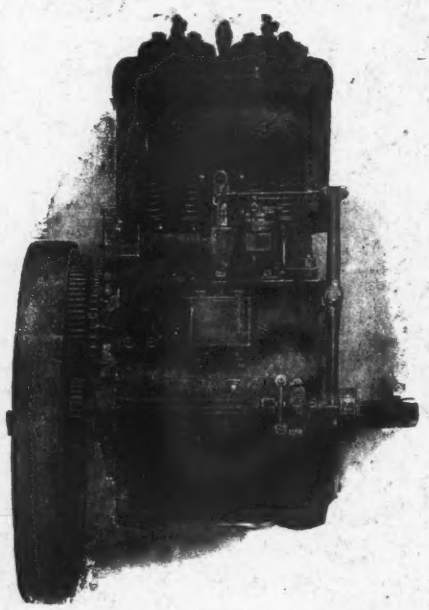

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THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE CONSERVATION OF NATIONAL RESOURCES.

THOSE of our readers who study the technical Press of the United States are familiar with the importance which in recent years has been attached to the subject which forms the title of this article by our Western cousins. Not only has the waste of material resources such as timber and coal been freely denounced in that great country, which possesses such enormous reserves of these priceless treasures, but also the punishments which Nature remorselessly inflicts upon those who misuse the riches which she has lavished upon them in prodigal profusion, have been the subject of discussion—such as, for instance, the denudation of the land by rainfall when it has been unwisely divested of the protecting mantle of forest growth; and the wealth of water-power which is running to waste, while coal, oil, and gas are consumed at low efficiency, has received the attention of the leaders of the industrial world and of the Government.

If, in a time of profound peace, a country so lavishly endowed with natural resources should be gravely concerned as to the abuse of those treasures by its inhabitants, how much more urgent is our obligation to scrutinise minutely the manner in which the natural resources of these islands are utilised, at a time when the heaviest financial burdens ever laid upon a nation have to be borne by us, to ensure the triumph of our cause, and when we have to face the certain prospect of industrial competition of unprecedented severity in the years that will follow that consummation of our aims. Surely it is our duty to examine in every phase the methods of production and utilisation, especially of the fuel which constitutes by far the most important store of natural wealth in our possession—the factor to which is primarily owed our evolution from an agricultural community to the leading industrial nation in the world.

The subject has many times been dealt with in our columns, but never before has its importance been so pressing or its urgency so obvious as it has now become; and we are glad to know that leaders in the scientific and industrial spheres, such as Professor Bone and Sir R. A. S. Redmayne, are endeavouring to direct public attention to the question. The work of the former in the development of more economical methods of heating with gas is well known to our readers; the latter, H.M. Chief Inspector of Mines, is more immediately concerned with the extraction of our black diamonds from their age-old matrix, but in his presidential address to the Institution of Mining and Metallurgy last month he broadly reviewed the mineral resources of this country, unrivalled in their number and variety, and insisted upon the imperative necessity of the conservation of coal by the prevention of waste both in getting and in using it. With each of these operations the electrical engineer is intimately concerned.

As regards the extraction of the coal, the progress of electrification of the coal mines in the recent past has been so satisfactory that we need not dwell long upon this phase of the subject; not only is the adoption of electric lighting and power

for ordinary purposes proceeding apace on all progressive properties, but also the number of electric haulages and electric coal-cutting machines in use is steadily increasing, and the use of electric power for main winders has passed the stage of experiment—in spite of the efforts of some faint-hearted electrical engineers who upheld the superior advantages of steam—and has established itself on the basis of proved merit. Not only do these methods reduce the consumption of fuel, but also they enable thinner seams to be worked to commercial profit and diminish the amount of coal abandoned in the pit or cut to waste.

But it is in connection with the use of coal that by far the greater scope for economy is found. Even if we ignore the fact that only at most about one-fifth of the energy contained in the coal can be utilised in steam engines, or one-third in the more costly gas engine, it is estimated that two-thirds of the coal consumed in industrial works is wasted owing to the employment of obsolete and inefficient methods and plant. Sir R. A. S. Redmayne refers to the appointment by the British Association of a strong committee to consider the whole question from a national standpoint, but considers that the matter is of so great importance that it should be undertaken by a State Commission provided with adequate funds and the whole-time services of able chemists. No electrical man will be surprised to learn that he comes to the conclusion which is reached by every engineer who studies this problem—that the more economical consumption of fuel for the production of energy depends upon the more extended employment of electric motive power, distributed from large generating stations in which the fuel is used most economically under the direction of highly skilled experts. *The centralisation of production and transmission lies at the very foundation of progress towards the conservation of our national stores of fuel.* This is no new doctrine; it is that taught by Ferranti, its first and most enthusiastic champion, and supported by such men as Insull, Merz, Pearce, Chattock, and other leaders in the electrical world. Wherever it has been carried into full effect, the results have proved its truth beyond all doubt. In this country, most unfortunately, the generation and distribution of electrical energy, with rare but instructive exceptions, is subdivided amongst innumerable undertakings of comparatively small dimensions and limited scope for development, thanks mainly to the craze for municipal ownership which for over 30 years has crippled the progress of the industry in this country, by maintaining a high cost of production and thus hindering the general adoption of electrical energy for all purposes, by preventing our manufacturers from developing the design and production of electrical plant on the grand scale in vogue abroad, and consequently by restricting the inflow of capital into an industry in which we for a time led the world. These facts are fully appreciated by Sir R. A. S. Redmayne, who points to the necessity of financial outlay on a large scale, and of legislative assistance to facilitate, if it cannot compel, the co-operation of municipal and private enterprise to carry the policy into effect. His views are in accordance with those which we have so long upheld in these columns, and we trust that the attention which is now being directed to the subject will bear fruit in the speedy liberation of the electricity supply industry from the toils by which it has hitherto been harassed.

Rubber.

Rather more conservative views have been of late ventilated in some quarters as to market prospects in crude rubber for the near future, which has been quite in keeping with the downward tendency in values within the last few weeks. Current prices, however, are still well above the lowest point reached at the end of January last, and the market looks like displaying more resisting power, while the demand throughout has continued on a fairly active scale. The price of spot fine plantation descriptions has dropped to a little under 3s. 4d. per lb., but the fact is worth noting that the fall has been accompanied by a decrease in the London stocks, thus indicating that the outlet has been stimulated at least to some extent at the lower level, while holders have evidently met the demand more freely. This policy has no doubt been prompted by the fact that very liberal quantities were already tendered against contracts maturing this month, which naturally tends to remove all apprehensions as to a renewal of tightness for some time to come. Not only are large quantities afloat, but consumers and importers on either side of the Atlantic undoubtedly hold fair stocks against urgent requirements that may arise in the course of this or next month. The remarkable strength of the position in the early part of this year was probably due in some degree to the rather oversold condition of the market at a time when the shipping situation was the subject of more particular uneasiness. There is now certainly less alacrity on the part of consumers to provide for their prospective needs pending further developments, but the postponement of orders in various directions means a slow accumulation of buying power later on. Recent heavy arrivals having synchronized with a reduction of the stocks and a fall in prices, precisely the reverse is liable to occur should anything happen to encourage the nursing of part of the future arrivals. While there is now a good supply of the commodity to meet all requirements in the home trade and for export, the outlook as regards shipping is not altogether free from anxiety. There have been delays to contend with in the arrivals, but no losses at sea lately with the exception of one boat last week, with only a limited quantity, however. The total shipped last month from the Federated Malay States amounted to 4,429 tons, this showing a reduction of about 800 tons against the previous month, and making an aggregate of 14,197 for the three months, which compares with 10,302 tons and 7,321 tons for the same period respectively in the previous two years. The fact deserves notice that the ratio of increase so far this year has been much greater than last year, thus testifying to the excellent progress of the plantation industry. The trade outlook across the Atlantic continues eminently satisfactory, and the continuance of a huge outlet there seems assured, which constitutes a big factor in the situation although the plantation output is steadily increasing.

Falling Trees and the Maintenance of Wires.

The blizzard which swept the country in the early days of the present month did considerable damage to electric wires and poles. Questions have already arisen as to who is liable for the damage caused to persons using the highway; and difficult problems are sure to arise as to who is liable to make good the damage caused by falling wires and poles, whether used for telegraph, telephone, or electric power. One such problem has already been brought to our attention by a correspondent. An engineer had undertaken to maintain and keep in repair certain poles and wires for a power company, and had given an indemnity in respect of all liability which might be incurred by the company owing to failure to maintain. A pole fell during the recent blizzard and damaged a cottage. The pole was new, well set up, and well stayed. If a claim is made by the cottage owner, can the engineer be sued on his indemnity? In the first place one has to consider whether the cottage owner has any right of action. This question depends upon a well-known principle that anyone who brings on to his land something

which may in certain circumstances be a source of danger, cannot escape responsibility if it causes damage even as a result of the act of God. In the present instance the pole, bearing certain heavy wires, was presumably built on land of the company in such a position that if it fell it would injure the cottage. In such circumstances the company would be liable. On the contrary, if a tree growing on their land was blown down and did damage, they would not be liable, as to grow a tree is to make a natural use of land. But the fact that the company may be liable does not necessarily give them the right to sue on the indemnity. So far as appears from the facts stated by our correspondent the fall was not caused by the failure to maintain but by the blizzard—a very different matter. For all ordinary casualties resulting from the failure to maintain he would be liable, but not for the consequences of an unprecedented storm.

One Too Many.

The British Manufacturers' Association, which was formed a year ago, held a meeting at Cannon Street Hotel last week. What struck us as one of the most singular features of the gathering was the complete silence observed by the speakers concerning other efforts which are on foot to establish a great organisation of British manufacturers. There may have been very good reason for running separate movements up to a point, but, as we stated last week, if the manufacturing interests of the British nation are to deal effectively with the unique position which confronts us all, and are to carry weight with the Government and the public, they should act in union, bringing their great combined influence to bear through one strong representative organisation. Some of the speeches must have terribly bored the majority of those present. The Association has issued a booklet, "Better Times for Working People," for the education of the workers, and it has very definite ideas as to what the Government ought to do to prevent a great German "after-the-war dump." Some of its spokesmen are votaries of co-partnership, which English masters have been so slow to adopt, and which working people through their unions have so often treated with suspicion. The idea of convincing the worker that the interests of Capital are the interests of Labour too, and that both parties should therefore pull hard together, is excellent at any time, but surely for that sort of propaganda one hardly requires a "British Manufacturers' Association." Nor does one want another association to petition the Government to set up a Ministry of Commerce. If the new association was intended to serve the purpose of a sectional body to represent some particular trade, or some particular object, and were to connect up to whatever main body may emerge from the deliberations referred to in our leader of last week, it would be more welcome than it is in setting itself up under so ambitious a title as though it were the only pebble on the beach. One of the speakers, who is connected with the electrical trade, referred to the need that exists for one manufacturers' organisation which should be sufficiently powerful to stand against all opposing forces. One could only imagine that those responsible for the gathering were unaware of the important movements which have been making such substantial progress in recent months. To anybody who has closely followed the course of affairs, the proceedings were not impressive, the speeches were long-winded and unbusinesslike, and certainly many of the audience showed their interest by an early retirement. To be perfectly frank, our own opinion concerning the movement was that it was one too many. While it might fill a useful object if it were to represent particular trades, including leather, it is not needed for the electrical or engineering industries of the country.

THE EFFECT OF THE PRESENCE OF MOISTURE IN GAS COKE FUEL.

By PAKENHAM BEATTY, A.M.I.E.E., and A. F. SMITH.

The figures given in the following notes are based upon the results obtained in every-day practice during the consumption of 10,000 tons of gas-works coke, in the boiler house of a tramway power station in Buenos Aires.

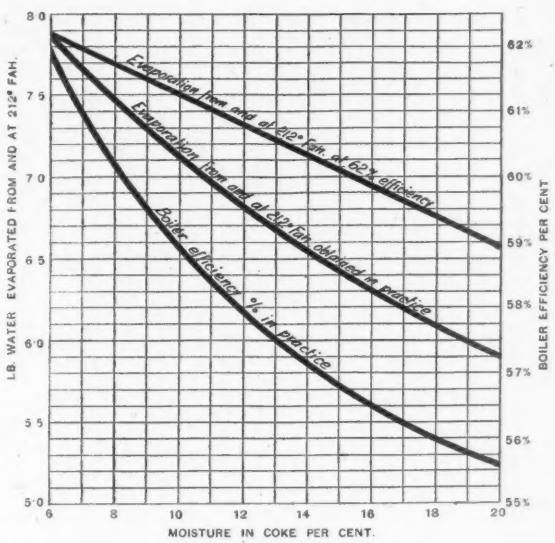

LB. WATER EVAPORATED FROM AND AT 212° FAH.
BOILER EFFICIENCY PER CENT
Evaporation from and at 212° Fah. at 62% efficiency
Evaporation from and at 212° Fah. obtained in practice
Boiler efficiency % in practice
MOISTURE IN COKE PER CENT.

Fig. 1.

Owing to the large stocks of coal it is usual to carry in Argentina, it was not until perhaps February of 1915 that the rise in the price of Welsh coal, following on the declaration of war by England, made itself felt. During February and March of 1915 Welsh coal, the normal price of which

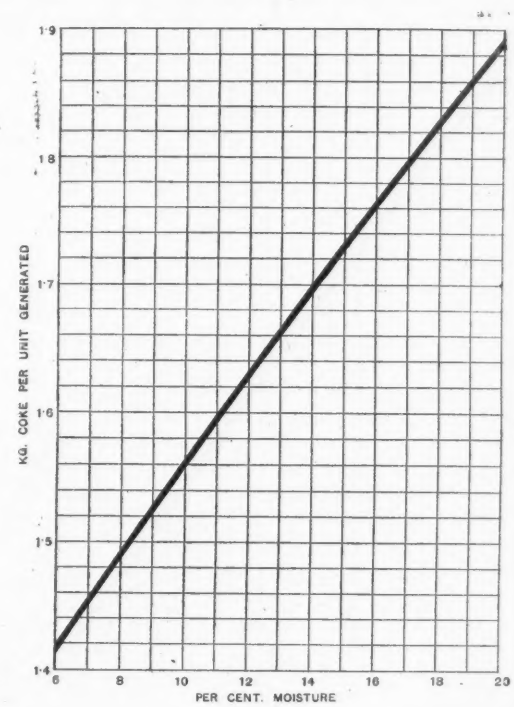


Fig. 2.

is about 33s. per ton c.i.f. Buenos Aires, rose to the unprecedented figure of 73s. per ton.

Only in June of 1915 were first-rate American coals such as Pocahontas, New River, and Georges Creek, obtainable

at 45s. per ton c.i.f. and, although petroleum is actually found in Argentina and a supply from Mexico has also been available since the commencement of the war, in the case of large installations where the capital required for the necessary modifications and additions to the plant represented a considerable sum of money, difficulty was experienced in making contracts at a convenient price for such a length of time as would warrant the expenditure involved.

Apart from the appreciable amount sold for domestic purposes in Buenos Aires, gas coke is also largely used in lime kilns, but the general trade depression caused by the state of affairs in Europe reduced the consumption of this fuel to such an extent that it was placed within the reach of the power-house engineer.

The generating station mentioned in these notes consists of two separate plants. The first and older section contains five slow-speed horizontal reciprocating engines, coupled to direct-current generators, giving a total output of 4,500 KW., and nine Babcock & Wilcox marine-type hand-fired boilers, varying in size from 49 to 105 sq. ft. of grate area. The total heating surface of the battery of boilers is 24,710 sq. ft., and the total grate area 651 sq. ft.

The annual production in units is about 16,800,000, and the average total steam consumption per unit generated,

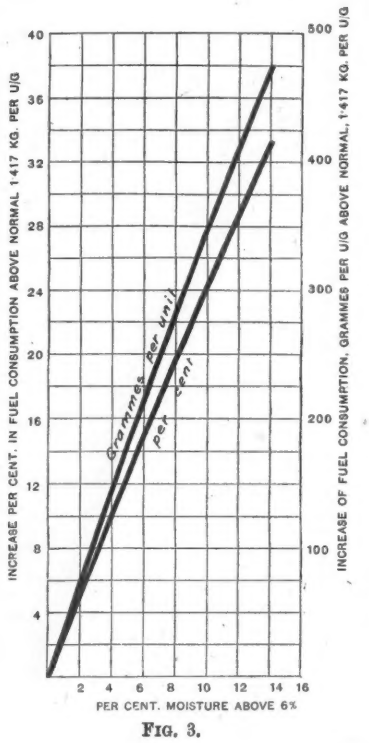

INCREASE PER CENT. IN FUEL CONSUMPTION ABOVE NORMAL 1·417 KG. PER U/G
INCREASE OF FUEL CONSUMPTION, GRAMMES PER U/G ABOVE NORMAL, 1·417 KG. PER U/G
Grammes per unit.
Per cent.
PER CENT. MOISTURE ABOVE 6%

FIG. 3.

including that required for all auxiliaries, works out at about 20·94 lb. A consumption per unit generated of 2·74 lb. of Welsh semi-anthracite coal, with a calorific value of about 14,000 B.TH.U. per lb., gives an annual boiler efficiency of about 62·5 per cent. The above figure includes the fuel for banking fires at night, which amounts to approximately 3 per cent. of the total coal used. When coal is employed, a maximum of 22·37 lb. per sq. ft. of grate area per hour is burned, while the average during the 24 hours is 15 lb.

The annual feeder load factor works out to 49 per cent.

The second, or more modern section, of the plant contains two turbo-alternators, each of 1,500-KW. capacity, and four Babcock & Wilcox land-type boilers, each of 76 sq. ft. grate area and 4,020 sq. ft. heating surface, fitted with under-feed mechanical stokers. Economisers are not installed in either boiler house, but exhaust-steam feed-water heaters are used.

Approximately, 10,750,000 units per annum are generated by the turbo-generators, one of which is always running continuously at nearly its normal load. The coal consumption in this case is about 1·975 lb. per unit, the steam consumption 17 lb., and the annual boiler efficiency 70 per cent.

An analysis of a representative sample of the gas coke used, made by Mr. A. Courtenay Luck, F.I.C.S., gives the following results :—

Elementary Analysis. (Sample dried completely at 110° C.)		Other Data.	
Carbon ...	88·15 per cent.	Sulphur ...	1·51 per cent.
Hydrogen ...	·94 ,,	Volatile matter lost on heating away from air	2·96 ,,
Ash	9·81 ,,	Calories per kilogram by Mahler bomb, dry fuel	7,589
Oxygen and nitrogen by difference ...	1·1 ,,	British thermal units	13,660
	100·00 per cent.		

The calorific value obtained by the Mahler bomb agrees fairly closely with the calorific value as calculated by formula from the elementary analysis.

The coke was burned under the marine-type hand-fired boilers, and the average results obtained during the consumption of 10,000 tons are set out below :—

Lb. per KW.-hour	3·675
Lb. of steam per lb. coke as fired	5·7
Lb. of steam per lb. coke from, and at, 212° F. ...	6·72
Boiler efficiency, per cent.	57·6
Ash, per cent.	13·5
Moisture, per cent.	13·0

The ash, on being weighed as taken out of the boiler house, after being quenched, was found to contain 20 per cent. of moisture. The best results obtained were with a large quantity of coke that contained 6 per cent. of moisture, when an average evaporation of 7·9 lb. of steam from, and at, 212° F. per lb. of fuel, was attained during trials extending over a month. After making the necessary deductions for the increased percentage of incombustible matter found in practice, and for the amount of water present, this evaporation corresponds to a boiler efficiency of 62 per cent.

Assuming it were possible to maintain a boiler efficiency of

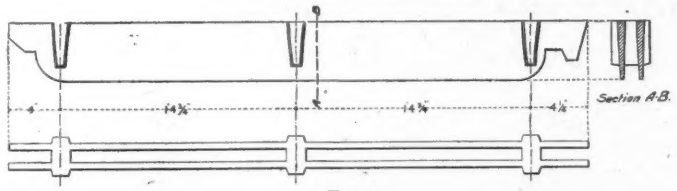


FIG. 4.

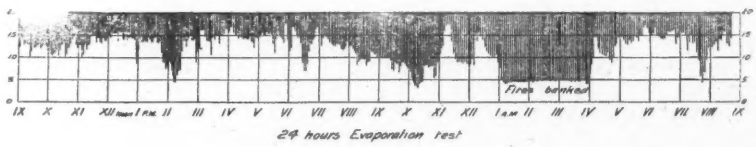


FIG. 5.—PERCENTAGE CO_2 RECORD.

62 per cent., the curve in fig. 1 was drawn showing the evaporation from, and at, 212° F. to be expected, taking into account both the increased percentage of incombustible matter in comparison with that set out in the analysis and the moisture present in the coke. As a result of subsequent trials, all extending over several days, a second or lower curve was constructed, showing the evaporation obtained in practice with varying percentages of moisture.

The loss of boiler efficiency due to the presence of moisture is also plotted on Curve No. 1. It will be noted that with 20 per cent. of moisture, about 55·6 per cent. efficiency is the highest that could be reached.

The curves in figs. 2 and 3 were plotted in order to show the enormous increase in fuel consumption per KW. produced due to the combined effect of the drop in efficiency and the losses expected from the presence of moisture. From Curve No. 3 it is apparent that a 10 per cent. rise in moisture over the normal, which was taken at 6 per cent., meant a 24 per cent. increase in the fuel bill.

In the case of all the evaporation performances in practice given above, the amount of fuel employed for banking fires is included, or, say, 3·5 per cent. of the total amount used.

It should here be mentioned that the climatic conditions under which the fuel was burned were exceedingly unfavourable to such a hygroscopic substance as coke. The extremely high percentage of moisture was found during periods when heavy rains fell and the average relative humidity varied between 80 and 85 per cent. Six per cent. would, however, appear to be the minimum amount of moisture gas coke is likely to contain, even in dry weather. With this amount of moisture, 1 ton of coke occupied 2·45 cubic metres as against 1·1 cubic metres in the case of the Welsh coal usually burned. In other words, 1 ton of coke occupied about 2·25 times more space than Welsh coal, and the extra work entailed was the cause of some complaint from the stokers.

The highest rate at which coke containing 6 per cent. of moisture was burned reached 18 lb. per sq. ft. of grate area per hour, but when the moisture rose to 20 per cent., as much as 23 lb. per sq. ft. of grate area had to be consumed in order to keep pace with the load.

A sketch is given herewith of the type of fire-bar employed (fig. 4). As the ash-pits contain water-troughs, no difficulty was experienced at all in keeping the fire-bars cool. The ash formed was exceedingly troublesome to remove, forming a layer some 1½ in. thick over the fire-bars, that greatly hindered the passage of air through the fire.

In fig. 5 is given a CO_2 record that represents an average diagram. Frequent and careful tests made with an Orsat set only served to confirm the high percentage of CO_2, and failed to detect the slightest trace of CO.

As it was possible to keep the amount of coke burned per sq. ft. of grate area per hour down to about 15 lb., except during the short peak load in the evenings, it was not considered necessary to go to the expense of fitting forced draught apparatus. All attempts to use coke in the automatic stokers ended in failure, owing to the burning of the bars and other parts of the stokers.

Extended trials made with coke breeze gave the following mediocre results, chiefly due to the extremely high percentage of ash that necessitated frequent supplementary cleaning of the fires by hand, on account of the impossibility of dealing, by means of the usual mechanical cleaning devices fitted, with this unusual quantity of incombustible material.

Lb. breeze per KW.-hour	3·196
Lb. steam per lb. breeze as fired	5·319
Lb. steam per lb. of breeze from, and at, 212° F. ...	6·282
Boiler efficiency, per cent.	55
Ash, per cent.	17
Moisture, per cent.	13

An analysis of the coke breeze is given below :—

Elementary Analysis. (Sample dried completely at 110° C.)		Sulphur ...	1·15 per cent.
		Volatile matter lost on heating away from air	2·60 „
Carbon	83·1 per cent.	Calories per kilogram by Mahler bomb	7,318
Hydrogen ...	1·02 „	B.TH.U. per lb.	13,170
Ash	15·2 „		
Oxygen and nitrogen by difference ...	0·68 „		
	100·00 per cent.		

The endless difficulties experienced in attempting to obtain the efficient combustion of substances containing as much as 33 per cent. by weight of ash and moisture have not, as indeed might be expected, caused the authors' opinion of coke and coke breeze to be unprintable.

The few pleasant moments spent during the trials, even with the coke breeze, which on one occasion gave as high a boiler efficiency as 58 per cent., when things went well, were sufficient to show what excellent fuels both coke and coke breeze might be under happier conditions.

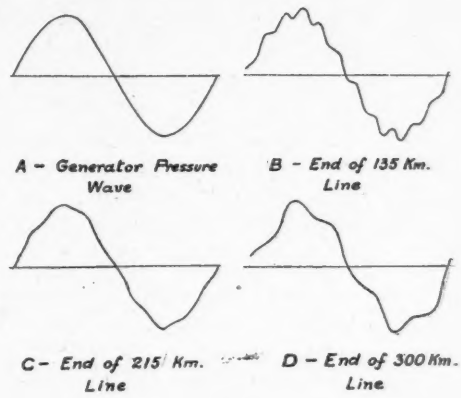
Spain.—La Sociedad Espanola de Industria Electricas is the name of a new undertaking which has lately been started in Madrid (Plaza de Carlos Camboronero), to carry on an electrical engineering business.

Fire.—On Friday morning last, damage to the tune of £2,000 was done by fire at the premises of the Yorkshire Cable Co., Ltd., Old Park Works, Bradford. The testing department and insulating shed were saved, and there will be no stoppage of work as temporary premises will be secured to replace those destroyed.

PRESSURE CURVES OF LARGE HIGH-TENSION NETWORKS.

It is now generally realised that, under suitable conditions, the distributed inductance and capacity of overhead lines may lead to serious pressure rise at the end remote from the charging station. Ordinarily, these phenomena are not apparent at commercial supply frequencies, but they may be set up by the higher harmonics of an impure pressure curve. Modern turbo-generators, with cylindrical rotor and distributed winding, give a practically pure pressure curve, which retains its sinusoidal character at all symmetrical loads; but, even so, quite impure curves may be obtained on long overhead lines fed from turbo-generators. Inductive loads reduce the tendency to such results, but capacity loads increase the tendency, and the use of transformers between generator and line also favours distortion of the pressure curve.

Small though the harmonics be in the pressure curve of a modern turbo-alternator, they are magnified by overhead lines and by step-up transformers feeding the latter. The impurities in the wave are more noticeable on the secondary than on the primary side of the transformers, and increase in amplitude, the greater the length of line to the observation point. As their amplitude increases, the harmonics are apt to cause disturbances on telephone lines, converter flash-over, and other troubles. From an analytical consideration of pressure and current distribution on an open line, it may be shown that the harmonics in the generator pressure



wave are not all magnified by an equal amount in the line. One harmonic is magnified more than the others, and which it is depends on the electrical constants of the line and on its length. The various waves are distributed (in space) along the line according to a cosine function. Full mathematical proof of this and subsequent statements, involving simple, but very cumbersome, equations, is to be found in a recent issue of the *E.T.Z.*, whence these notes are derived.

Suppose that a 50-cycle turbo-alternator is connected to a line which has (per 100 km.) an inductance of 0·15 henry, a capacity of 0·75 mfd., and a resistance of 20 ohms. Calculated curves plotted as above, show marked pressure-wave distortion, despite the purity of the generator wave. The latter is shown at A; and B, C, D, respectively, show the form of the pressure curve at the end of a 135-km., 215-km., and 300-km. line of the above characteristics. In cases B, C, and D respectively, the 11th, 7th and 5th harmonics are specially magnified. The conditions assumed may be considered somewhat exaggerated, but, on the other hand, the generator wave assumed is of exceptional purity and symmetry, and the resultant distortion depicted does give a fair idea of practical occurrences.

The effective resistance of an A.C. line increases as the frequency becomes higher. This effect is not pronounced for lower harmonics than the 11th in waves of commercial frequency (say, 50 cycles), but it prevents higher harmonics from resonating to any marked degree. It can be shown mathematically that an inductive load connected at the end of an overhead line tends to suppress resonance, and hence prevents individual harmonics from attaining excessive amplitude. On the other hand, a load of high capacity or leading power factor favours resonance of the higher harmonics in the generator wave to an extent dependent on the ratio of the load and line capacities. By combining capacity and inductance in series at the end of the line, to form an oscillating circuit tuned to any particular harmonic, the latter is almost entirely suppressed.

In almost every case in practice, overhead lines are fed through step-up transformers, and the precise effect of the latter as regards pressure distortion depends on their construction and characteristics, but by assuming the simplest possible type of transformer, and making perfectly general assumptions as to electrical characteristics, it is possible to demonstrate mathematically that, even on light load, large transformers may cause pronounced magnification of harmonics in the secondary pressure wave, the natural frequency of such transformers being sometimes as low as 500 cycles per second.

INDUSTRIAL RESEARCH IN THE U.S.A.

Under the auspices of the Council for the Organisation of British Engineering Industry a lecture on "Industrial Research" was given in the Manchester School of Technology on Tuesday, April 4th, by Mr. A. P. M. Fleming, M.I.E.E. There was an attendance of about 300. The chair was taken by Mr. Chas. Day (Messrs. Mirrlees, Bickerton & Day), who mentioned that at the works in which he was interested a small laboratory was provided in which new ideas were tried and developed before being finally adopted on engines supplied. The laboratory certainly cost something to run and maintain, but it paid for itself in many ways. He thought it a mistake to embody new ideas without first having given them a thorough trial, and he considered the last person to experiment on was a customer.

At the close of the lecture, a vote of thanks was accorded to Mr. Fleming, on the motion of Principal Garnett, of the Manchester School of Technology, who gave an outline of the research work carried on in the School in conjunction with the Manchester Association of Engineers.

The following is an abstract of the lecture:—

An industry depends for progress on a continual influx of new knowledge, and it may be conceived that industrial research embraces all means whereby this new knowledge having application in industry can be obtained.

Industrial research in the United States is mainly accomplished by individual firms, although a good deal is done in the universities and national institutions.

As regards the work of individual firms, during the past ten years there have been very considerable sums spent by the leading manufacturing corporations to provide facilities for scientific investigation. Annual expenditures for this purpose of £25,000, £50,000, and even £100,000 are not uncommon.

Among the important features of the work of many of these private laboratories is the equipment of full-scale manufacturing plant, which enables discoveries in the laboratory to be fully tried out and manufacturing methods perfected, relieving the manufacturing departments from the hampering effects of new developments. Many of the laboratories also are equipped for the manufacture on a commercial scale of some of the commodities developed from their discoveries which are not of a character adapted to production in the manufacturing departments. The laboratory production in such cases is continued until it reaches such dimensions as justify the starting of a separate works. There is a growing tendency in many of the research laboratories to devote more and more attention to investigations in pure science having no immediate commercial object in view, with an appreciation of the fact that almost invariably such investigations result in some industrial application, sometimes resulting in the development of entirely new industries. Prominent examples of this kind are represented by the work of the General Electric Co.'s laboratory, at Schenectady, and the National Electric Lamp Association. In connection with such work, a very broad-minded policy is shown by the publication of the scientific investigations carried out.

It is also noteworthy that these research laboratories serve as very effective advertising means, by inspiring confidence in the minds of purchasers as a result of such visible evidence of scientific working.

There appears to be no doubt that these laboratories have proved financially successful, not only in that they afford the greatest possible assistance to the works with which they are connected in solving manufacturing troubles, developing new materials, methods, tools, and making discoveries which result in new industrial developments, but also in the direct manufacture and sale in many cases of valuable products straight from the laboratory.

A great deal of the research work of the universities is devoted to purely scientific investigations arising in connection with the preparation of degree theses by students, and from work done by the staff in their spare time. Apart from this, however, many investigations directed to the solution of particular manufacturing problems are carried out for private firms, and in a number of cases experiment stations have been arranged, the staffs of which devote all their time, or most of it, to research investigations.

In connection with Columbia University, it is proposed to erect a laboratory specifically devoted to research, the cost of which it is estimated will be of the order of £130,000 for buildings and equipment, and it is expected that an endowment fund, for extension and maintenance, of from £400,000 to £1,000,000 will be required. This proposal appears to be inspired to some extent by the success of the research laboratories associated with the large industrial corporations already referred to, and it is realised that there are many smaller manufacturers who are unable to support individually the burden of such laboratories, but who would be glad to avail themselves of the opportunities which this university research laboratory would afford.

An important feature of the proposal is the intention of devoting means to the collection of all possible information bearing on the industrial problems that are likely to be considered.

The most striking feature of the research work of the universities is this provision of research facilities and the use of a staff of highly-trained scientific men who can devote their whole efforts to scientific investigation without the handicap of a great deal of teaching work as well as of financial anxiety. It is also noticeable that increasing numbers of young men who have taken their bachelor's degree proceed to a doctor's degree, possibly on account of the extended opportunities for employment now presented by the increasing number of research laboratories for men of the highest scientific training.

While there is as yet no national plan of industrial research, there are tendencies in that direction, some of which are directed to linking up the efforts of the universities, the extension of the experiment station scheme to a number of universities and colleges, and the co-ordination of the work of some of the existing laboratories connected with industrial concerns.

The work done in the United States is of considerable value to us in this country in enabling us to shape our own schemes with reference to research. The distinguishing feature of work done in America is that it is mainly in the hands of private companies, and is carried out in order than one company may more effectively compete with another. The development of the internal resources of the country has occupied most attention, and little work has been done with a view to encouraging export trade. In this country our export trade is of the first importance, and it is here that the country most feels the pinch of German competition. The opportunity, therefore, arises to take the greatest possible advantage of laxity in the past and, at the same time, to take steps to conserve our overseas trade.

This can only effectively be done by co-operating and pooling our scientific resources, which have hitherto lacked organisation. Doubtless each manufacturer will in future provide himself with a small laboratory where manufacturing difficulties peculiar to his own works can be solved, but the big advances in the future can only come by concentrating advanced research in a large central institution. The materials, tools, and processes which are common to any industry would be considered in such an institution and efforts devoted to improving them for the common benefit of the industry. Processes which are the monopoly of any individual firm would have to be left out of such a scheme. Differences of factory organisation and management and methods of distribution would still enable manufacturers to compete amongst themselves, but the whole industry would be lifted to a higher plane through discoveries arising from work done at a research institution, which would enable foreign competition to be met most successfully.

Such an institution would comprise a laboratory for each of the great industries housed in a large central building. Much of the work done would be along lines of pure science investigation so as to ensure priority of new applications in industry. Patents would be taken out on behalf of the Government, and manufacturers in this country or the colonies would be licensed to manufacture at a nominal charge. Work would be done without the overlapping which inevitably occurs among a number of different institutions, and which results in great lack of economy, and administrative expenses would be kept to a minimum.

The above scheme presents advantages over any proposal to distribute the research work among the universities.

English people seem to possess a certain industrial genius which assured them priority in the industrial world in the past, and the records of our inventors and discoverers lead to the belief that what has happened in the past may with suitable organisation be repeated in the future.

RÖNTGEN SOCIETY.

At the meeting of the Röntgen Society, on April 4th, Mr. B. H. Morphy and Mr. S. R. Mullard read a paper on the subject of the enclosed tungsten arc as a source of ultra-violet light. They have adapted the new "Pointolite" lamp of the Ediswan laboratories to a therapeutic purpose by enclosing it in a quartz bulb, so that the ultra-violet output is very largely increased. The open tungsten arc had a spectrum which extended further into the shorter wave lengths than did the enclosed arc, but even if these very short wave lengths were of therapeutic value, the authors contended that the sputtering of the open arc and its constant need of attention militated against its value in hospital work. The enclosed arc gave off a large quantity of ozone, owing to the ultra-violet radiation, thereby showing that its value in this direction must be considerable. If the lamp was over-run, the rays obtained extended much further into the ultra-violet, but this practice, of course, diminished the life of the lamp.

Major Wilson, of the Canadian Medical Service, said that ultra-violet light was proving of great use in the treatment of wounds at the base hospitals, and the French were using it extensively. He had himself made some experiments with a view to obtaining ultra-violet light of much shorter wavelength than hitherto by striking an arc in tungsten vapour, or using a tungsten base as one electrode, and a carbon as the other.

Mr. E. Schall, B.Sc., read a paper on some experiments he had been conducting with a Coolidge tube. He said that he thought it possible that X-rays might be discovered having a quality so "hard" as to be capable of passing through sub-

stances, whether photographic emulsions or the tissues of the human body, while producing a very small effect indeed. He believed that the explanation of some curious phenomena he had observed in the case of the Coolidge tube was that the radiation from this tube was heterogeneous, and that the more current that was passed through it, the greater was the proportion of exceedingly hard radiation which could not be detected, and which approximated to the gamma radiation of radium in hardness.

Mr. P. J. Neate, one of the Governors of the Cancer Hospital, demonstrated a chronograph which he had constructed to work with the electroscope, in response to a suggestion by the hospital physicist that a chronograph substitute for measuring the duration of the electroscope readings would be very useful. The prime mover was a rotating gramophone cylinder, and by means of opposing magnets, armatures were oscillated in such a manner that a pen in connection with them was made to record a line of jerks corresponding to brief intervals of time.

At the same meeting the Society passed a resolution expressing concern at the present conditions of X-ray examination in naval and military hospitals, in view of the number of installations, some of which were believed to be defective in their means of protection, in the hands of inexperienced X-ray workers. The suggestion was made to the authorities that every installation, both at home and abroad, should be inspected by experienced radiologists.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Engineer in the Tropics.

I have to thank "Koie-Hai" in your issue of March 31st for his criticism of my article of March 17th.

His severe strictures upon my suggestion that corrosive sublimate should be carried seem to be the result of a misapprehension on his part. I thought I was quite clear in stating that corrosive sublimate was a *first-aid* remedy. It is not intended for a regular dressing.

During the time I spent up the Amazon River I was responsible for about 500 men; amongst such a number, accidents were of daily occurrence. When a man was brought into the First-Aid Station his wounds were completely washed out with a 5 per cent. solution of corrosive sublimate, thereby rendering the wounds completely aseptic, after which the usual dressings were applied.

Hundreds of cases were treated by this method, and, so far as I can recollect, we never had a case of septic poison in any wound so treated.

In view of this experience, I am still convinced that corrosive sublimate should be carried amongst the *first-aid* remedies in a tropical country.

Geo. R. Archdeacon.

Blackpool, *April 4th*, 1916.

Australia and the Metric System.

In my country, Australia, we have on our Statute Book a law which only requires a Royal Proclamation to banish all weights and measures outside of the metric. We have held our hands till now, because we feared to damage the trade which we bring to the Mother Country. If we despaired of your adopting the metric system, we should put our law into operation, for we cannot wait for ever. In the near future, we hope to see every young man studying science and, necessarily, learning and using the metric system. Shall we, in deference to your inertia, condemn those young men to learn, in addition, every remnant inherited from bygone attempts to establish a perfect system of weights and measures? Let us give credit to the more mathematical ancients for trying homogeneous systems, such as the Chaldean, with a basis of 60: but why take thence our time and angle divisions, from another our binary divisions of the gallon and the inch, from elsewhere a duodecimal division of the shilling, and of one breed of ounces?

One cannot help feeling that the greatest enemy of progress is the one who, like "Cantuck," has had a scientific training and advocates metric reform, but points with trembling finger to the dangers lurking in every change. Even the misfit of the ounce with the Canadian cent worries him, although it would (at 16 to the lb.) fit no better with the 12 pennies in the shilling.

Edward C. Barton,
Secretary, Queensland Decimal Association.

London, S.W., *April 10th*, 1916.

[We hope the Commonwealth will continue to exercise pressure upon the Imperial Government, with a view to hastening the advent of the reform which is so long overdue.—Eds. Elec. Rev.]

Cause of Flicker.

There seems little doubt that bad valve setting is the cause of flicker in many cases of relatively small steam direct-driven sets.

I am familiar with the very small sets which, placed beside the driver on his seat, provide the electric lighting on the steam omnibuses of the National Steam Car Co., running on the London streets.

It was the practice in setting the valves of these little engines to adjust till flicker disappeared, and the method was found simple and satisfactory, being much simpler than setting to measurements.

Charles H. Wright.

Glasgow, *April 4th*, 1916.

I have been interested in the correspondence on the above subject, as a very remarkable case of lights flickering came under my notice some years ago. The firm I was with supplied a generating set to a central station for town lighting, the set being the largest in the station at that time, and consisting of a high-speed steam engine direct coupled to two direct-current generators in line, one generator being connected across the middle and one outer, and the other across the middle and the other outer. The set thus formed a balancing generator set. Whenever this set was put on the bus-bars the lights flickered all over the town, which was of fair size. Although having previously had nothing to do with the design or manufacture of the set, I was eventually sent down to endeavour to locate the trouble. I went very carefully into the whole matter, and found that every part of the shaft and armature ran perfectly true, and all electrical details appeared to be quite all right on both machines. Now, there was a bearing between the two generators, and, of course, another bearing on the end spindle of the generator remote from the engine; there was a coupling between the two generator armatures, a spare armature had to be supplied, and all armatures had to be interchangeable. Thus, the outer bearing and the bearing between the two machines had to be the same size. Unfortunately, both bearings were made to the standard of the outer bearing for that size of armature. After my tests, I came to the conclusion that the journal of the shaft in the bearing between the two machines was too small in diameter, and was causing a whip. As this meant three new shafts, two new bearings, and altogether an expense of some hundreds of pounds, it was not accepted at once. However, eventually the alteration was carried out, and no further trouble was experienced. Thus, I would suggest that your correspondent should see if his shaft is not small somewhere between his engine and his generator armature.

Richard C. Dieppe.

London, S.E., *April 7th*, 1916.

The Council of the I.E.E.

I am pleased to see that your journal has taken exception to the nominations of what is, to all intents, a self-elected Council of the Institution, and rightly, when one considers that the country is passing through the most critical period in its history, and as far as the electrical industry is concerned, a crisis which, if not faced now, will mean after the war that English electrical houses will have to face competition seriously handicapped by the inroads which war has made. At such a time it is necessary that the Council of the Institution should have included on it men of *strong British* sentiments, whose one intention should be *Britain* for the *British* and a closed door to the enemy, with all his wares and hidden interests. It may be said that the Council of the Institution is not concerned with the commercial future of the electrical industry any more than it was in respect of excluding members of alien enemy origin, but it has been by popular demands very reluctantly forced to take steps towards dealing with such members, and there is no reason but to believe that equally dilatory action would be taken in regard to English commercial interests. It, therefore, behoves all members to see that this election is not as in previous years, but that other members are nominated against the Council's nominations and every endeavour made to elect them.

P. M. A.

WAR ITEMS.

Sports Outfits Wanted for the Front.—We have had a call from Corporal Watts, whose letter on "Wireless Wiring at the Front" appeared in our issue of March 3rd, page 271. He asks us to appeal to any of our readers who may not be using their sports outfits, or parts thereof, this year to send them for the Mechanical Transport Section at the Front. Cricket bats, stumps, and anything suitable for outdoor sport will be most welcome to aid in whiling away the half-holidays while waiting for the Huns. They should be addressed thus: Corpl. A. E. Watts, 5th A.S.P., B.E.F.

Glasgow and Enemy Aliens.—The "Times" says that a petition has been extensively signed in Glasgow calling on the Lord Provost to convene a meeting to consider the whole question of alien enemies being allowed to reside and trade in the city and whether alien professors and teachers should be allowed to occupy positions of profit.

D

Exemption Applications.—At Ilkley the engineer of the Ilkley Electricity Works (Mr. Sidney Bell) applied for a month's postponement in respect of his switchboard attendant. He said that the attendant was really engaged in a reserved occupation and would have been in order in applying for total exemption, but he only desired a month's postponement. The application was granted.

At Burnley Tribunal, last week, an electrician made application for his motor repairer and armature winder. The Mayor: It will be easy to have this work sent away?—Not at present. We are doing work for firms doing Government work.—Not assented to.

At Berwick-on-Tweed, on April 5th, the local electric light company appealed for Mr. R. Hamilton, accountant, of Tweedmouth, whose services were deemed indispensable. It was stated that he had been with the company for 16 years, and it was claimed that he would be of more use to the country if he was allowed to remain. Capt. Nicholls (Military representative): He receives two months' clear notice before joining. He comes under the group known as "Britain's last hope," and he is kept at work till everybody is called up. Six months' exemption was allowed on condition that he remains in his present employment.

At Southend-on-Sea, on April 3rd, exemption until June 1st was allowed Mr. W. C. Smith, chief electrical engineer to the Kursaal Estates, Ltd.

At Guildford, Sergt.-Major E. J. Nunn, electrical engineer, who is in the 5th Queen's Regiment, appealed for Mr. C. G. Howard, works manager, and Mr. H. O'Connor, electrician. He said that seven employés had enlisted, leaving only the two applied for. If the request was refused he would have to take his own discharge at the end of the month in order to look after the business. On Mr. Nunn undertaking to re-engage for general service, Mr. Howard was granted absolute exemption, and Mr. O'Connor was given three months, with leave to appeal again.

At Walton-on-Thames, Mr. Scott, electrical engineer with Mr. W. H. Davies, of Cobham, was granted two months' exemption on the recommendation of the military representative.

Mr. S. Terry, electrical engineer, Canterbury, appealed to the tribunal, on April 3rd, for exemption on the ground that he was at present best serving the national interests. He said it had taken him eight years to build up the business, and he was carrying out important electrical work in connection with two local munition works. If he was called up the business would have to be closed. He was allowed three months.

Dudley tribunal has granted two months' exemption to an electrical engineer responsible for the maintenance and repair of electrical plants at six works, all engaged on Government work.

Clacton-on-Sea tribunal has granted conditional exemption, acquiesced in by the military representative, to the electrical engineer of the U.D.C.

Before the Surrey County Appeal Court, Mr. J. H. Batchelor, accountant to Edmundson's Electricity Corporation, of Dorking, appealed against the decision of the local tribunal refusing exemption, but the appeal was dismissed.

The Rochdale Tribunal last week granted conditional exemption to Harry Sprigg, an electric wireman employed by Mr. G. L. Adamson.

At Hurst (Lancs.) an appeal under the Military Service Act was heard, the appellant, J. H. Brownson (20), electrical fitter, stating that he had tried to join the Colours, on three occasions, but had been refused because he was wearing a munitions badge. He had this badge on when he appeared before the Tribunal, and the latter decided that he was exempt, and need not have appealed.

Middleton Tribunal granted conditional exemption to a pavior and platelayer employed by the Middleton Electric Traction Co., and appealed for by them on the ground that he was solely engaged in the maintenance of tramway track and was "reserved."

At Salford, last week, an electric wireman engaged on installations at controlled factories received exemption until June 7th, and he told the Tribunal that if the country was badly placed he would be in the Army by then.—Also at Salford, an electrical engineer appealed for exemption and stated that his firm were engaged on making fittings for sea mines. The members of the firm had invested all their savings in the business and in getting the machinery together. Exemption was granted conditional on his continuing in his present employment.

Exemption to the end of May was granted at Warrington to an electrician at a local theatre.

At Stretford a foreman electrician employed by a local engineering firm stated that he had been passed for home service, but he had stiff hands. The appeal was disallowed.

At the Lincoln Tribunal application was made for an electrician who is working at a flour mill. He was only 23 years of age, however, and the chairman said he could not think the man was indispensable.—Claim disallowed.

At the Oxford Tribunal, the City of Oxford Electric Tramway Co. applied for absolute exemption for its chief engineer, electrician, a fitter's mate and a unit adjuster, and a number of motor 'bus drivers, on the grounds that their present employment was in the national interests, and that the men were in a certified occupation. The Court granted conditional exemption for the four cases named, theirs being certified occupations, but the 13 other cases were adjourned for two months.

Before the Berks Appeal Court, on April 4th, the Military appealed against six months' exemption allowed by the local tribunal to six employés at the Maidenhead Corporation Electricity Works. The exemption was reduced until June 1st, with leave to renew the appeal.

At Old Hill, a Brierley Hill firm of electrical engineers applied for exemption for an electrical engineer on their staff. For the firm it was stated that they were employed at several munition works, and if the man appealed for went they could not assist these works in case of breakdown. The tribunal granted a month for the firm to get the appellant badged.

At Farnham, on April 4th, Mr. H. J. Reed, electrical engineer, in charge of the mains of the Farnham Electricity Co., applied for exemption. He said that he was in partnership with Mr. Kimber, and they were under contract to repair, lay, and renew the mains of the company, and had been asked to do similar work for the Farnborough Electrical Works. Three months were allowed, with leave to appeal again.

Mr. W. Jackson, chief assistant engineer at the Llandudno Electricity Works, has been exempted so long as he remains in his present employment.

French Works in Enemy Occupation.—A year ago it was impossible for the Société d'Electricité et Gaz du Nord to submit full accounts for the year ended with June, 1914, owing to the company's electricity and gas works being situated in the districts invaded by the enemy and the inability to obtain the figures for the final three months of the financial year. The same state of affairs still prevails for that year and also for the succeeding twelve months. Nevertheless the directors have endeavoured to secure information relating to the condition of the works during the period of enemy occupation, but it has not been possible to correspond advantageously with those members of the staff who remained in the invaded territory. Information derived from Government sources, however, shows that the works and installations have not suffered serious damage since the non-military personnel is engaged on the supply of current to consumers under the control of the Germans. The conditions under which the supply of coal and other materials is effected, as well as the regulations in regard to the collection of accounts, are quite unknown to the company. The situation in respect of the interest possessed in the Société de Gaz et d'Electricité du Hainaut, Belgium, and the Société d'Electricité, of the district of Valenciennes-Anzin, has also undergone no change. These companies are circumstanced similarly to the Electricité et Gaz du Nord, as the war has interrupted normal working, but there is reason for assuming that the German occupation has not stopped the operation of the works.

The Supply of Tramway Rails.—In the March issue of the "Journal" of the Tramways and Light Railways Association it is stated that negotiations are taking place between the special committee of the Association and the rail manufacturers with a view to securing a supply of rails during the next twelve months. "Members have been asked to supply the secretary with the minimum quantity of rails and fishplates required by them for repairs which are absolutely necessary for keeping their undertakings going. The manufacturers have now been asked to quote prices at which they would be able to deliver these, and members will in due course be advised thereof. It will then be necessary to apply to the Minister of Munitions for permission to roll these rails, and to grant facilities for their delivery to the various tramways requiring them. It is hoped that a satisfactory result may be obtained." According to the arrangement made with the manufacturers last November, the price of steel tires for the quarter ending July next will be the same as for the past quarter.

Warsaw Telephones.—With the occupation of Warsaw by the Germans, the authorities forbade private persons to use the telephone system. An exception was made in favour only of members of the Citizens' Committee and magistrates. But considerable losses resulted from this order, not only to the Polish citizens, but to the private companies of neutral powers operating in Warsaw. Amongst those that suffered considerably may be mentioned the Swedish Sedergren Company, the director of which is the Swedish Consul. This company applied to the authorities to have the prohibition removed. The result of this application was, says the "Gazeta Polska," that the authorities authorised the use of telephone lines to stores, trading and commercial firms, and to a small number of reliable people. The remaining subscribers had to continue without the use of the telephones, which had to be retained in the control of the military authorities.

To be Wound Up.—Orders have been made by the Board of Trade requiring a number of other companies to be wound up (the total is now 100), including the following:—Berkefeld Filter Co., Ltd., 121, Oxford Street, London, W., filter and pump manufacturers; controller, G. M. Robinson, 3, Raymond Buildings, Gray's Inn, London, W.C. Maschinenfabrik Augsburg-Nurnberg A.G., Caxton House, S.W., manufacturers of gas engines, &c.; controller, B. E. Mayhew, Alderman's House, London, E.C.

French Economic Expansion.—The Paris correspondent of the "Daily Telegraph" states that a Commission was appointed recently by the National Association for Economic Expansion to examine the question of cartels and commercial "ententes." This body was composed of well-known politicians, economists, manufacturers, merchants, and agriculturists. The other day the chairman of the first meeting of the Commission, M. Guisthau, formerly Minister of Commerce, pointed out the difficult position in which French manufacturers are placed in respect of foreign competition by existing legislation, notably a clause of the penal code, which places French manufacturers at great disadvantage by depriving them of facilities enjoyed by foreign competitors in the liberty of making "ententes." The Commission is divided into two sections, economic and judicial, and these sections are now studying the question with a view to making considered proposals to be submitted to Parliament.

The Petrograd Lighting Co. of 1886.—A communication reported to have been forwarded by the Russian Prime Minister to the Moscow City Council states that the question of the liquidation of the Petrograd Electric Lighting Co. of 1886 is not yet ripe for discussion. The chairman of the company, Lieut.-General Swentorschitzky, is of the same opinion. During the war the company has merely remitted 166,409 roubles abroad, exclusively to allied and neutral countries, of which 53,000 roubles refer to England. The dividend declared for 1914 has not been paid. The assets of the company amount to about 60,000,000 roubles. If the Moscow City Council desire to take over the company's local works, the town must first ascertain whether it has now at disposal the necessary capital of 2,800,000 roubles.

St. Helens Corporation and its Contracts.—Considerable discussion took place at a meeting of the St. Helens T.C. on April 5th respecting the position of a firm manufacturing accumulators, from whom it was proposed to purchase plates. It was stated that the works were "controlled," and that contracts were being executed for the Government. A member of the Council objected to the firm having the order until the Electricity Committee had definitely ascertained that no British firm could deal with it. Sir Joseph Beecham said the committee had already ascertained this, and if the present offer was not accepted they would have to pay £600 extra. The Council rejected a proposal to refer the minute back to the committee.

Manchester Corporation Contracts.—At the meeting of the Manchester City Council on April 5th attention was called by Mr. McLachlan to tenders which the Tramways Committee had accepted for certain electric lamps, and it was asked whether the standing orders were complied with requiring that two-thirds of the capital of the companies tendering must be British controlled. He submitted that parts of the lamps in the tenders were monopolised by an article with a German influence, and he pleaded for fair play for the British manufacturer. Alderman Bowes assured the members that so far as they were aware the firms whose tenders had been accepted were British. If there was any doubt about it he would take back the minute. It was resolved that the minute relating to the tenders be referred back.

Lighting Prosecutions.—In a prosecution at Bolton, on April 6th, under the Lighting Order, one of the magistrates said he had every sympathy with the defendant because the Corporation should apply the law to itself before proceeding against ratepayers. The tramcars were setting a bad example in regard to lights, and these should be dealt with before the law was applied to citizens.

At Bury County Police Court on April 6th, the Lancashire E.P. Co., of Ainsworth, were summoned for a breach of the lighting restriction regulations. It was stated that the place complained of was a sub-station. A fine of 20s. was imposed.

Air-Raid Fatality.—At an inquest in a North-East Coast town upon the body of a local electrician it was stated that he had escorted a young lady home and was returning when the Zeppelin bombardment commenced. He was blown through a plate-glass window, and was found in the shop some hours later by a policeman. He was terribly injured and succumbed in the Infirmary. The jury returned a verdict of death from peritonitis, set up by injuries sustained through the explosion of a bomb thrown from a hostile air-ship.

Trading with the Enemy.—The "London Gazette" for April 7th contains additional lists of persons or bodies of persons with whom dealings are prohibited, in the Netherlands, Netherland East Indies, Portuguese East Africa, Morocco and Portuguese East Africa, also some amendments to earlier lists.

Not for War Service.—The Ministry of Munitions has declined to allow Dick, Kerr and Co., Ltd., to deliver to the Reading Town Council six motors for tramcars, on the ground that the motors are not needed for cars used exclusively for carrying munition workers. The cars were ordered last August.

Exports to China.—The "London Gazette" for April 11th contains a further list of persons and bodies of persons to whom articles to be exported to China may be consigned.

Municipal Corporations and Enemy Firms.—Other municipal bodies which have decided to give support to the action of the Manchester Corporation in adopting standing orders prohibiting trading with persons or firms of Austrian or German nationality or composition, include Crewe and Southport. The Nelson Corporation has decided to leave the matter alone. The Bury Town Council, after a lengthy discussion on April 6th, decided to take a similar course, an amendment that they should support the Manchester resolution being defeated by 17 votes to 15, two members of the Council remaining neutral.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Lanterns.

We illustrate herewith two of the latest patterns of Simplex fittings for industrial lighting with "half-watt" lamps. In these designs the æsthetic as well as the utilitarian aspects of the question have been studied, the glassware has been specially chosen, and provision has been made for using lamps of a wide range of wattage.

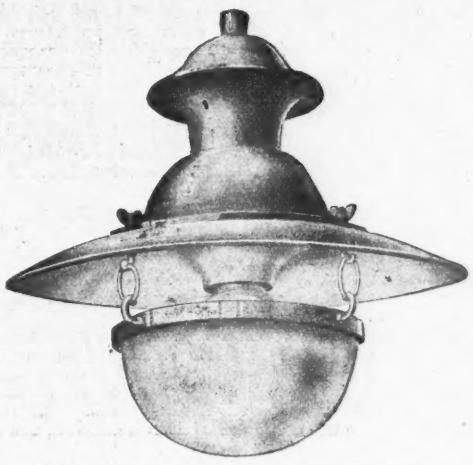


FIG. 1.—SIMPLEX SEMI-INDIRECT FITTING.

Fig. 1 shows a fitting for semi-indirect lighting, 20 in. in diameter × 20 in. high, for lighting large areas such as public halls, railway stations, &c., with lamps up to 1,000 watts.

FIG. 2.—SIMPLEX CONCENTRATING REFLECTOR.

Fig. 2 shows a reflector for workshop and office lighting, taking ordinary tungsten lamps up to 50 watts, and half-watt lamps up to 100 watts. A variety of other designs is available, including a number of anti-Zeppelin reflectors.

Safety Device for Electric Motor Vehicles.

Particular interest attaches to a safety device for electric motor vehicles, which has recently been worked out in the mechanical engineering department of the Eastman Kodak Co., the well-known photographic apparatus concern, of Rochester, N.Y., U.S.A., in that no patent has been taken out for it, the designers having commendably decided not only to make it known as widely as possible, but to couple with any publicity regarding it, the announcement that any user or builder of electric motor vehicles is at liberty to adopt the idea.

Like many other concerns in the United States, the Kodak Co. is a large user of electric delivery vehicles; it has also, in the interests of its many employés, a Department of Safety and Welfare, of which Mr. H. E. Akerly is the engineer. It has been found that despite the care exercised by trained drivers, it occasionally happens that when the vehicles are stopped by switching off the current, the speed control lever is not always at the same time brought back to the neutral position, with the result that, overlooking this fact, the car bounds away unexpectedly when the current is again switched on, with the risk of causing both physical injury and material damage, and even giving rise to fatal accident. It was occasional experiences of this kind that led the Department of Safety and Welfare to introduce on all the Kodak Co.'s fleet of electromobiles the safety device illustrated herewith, and by means of which it has been rendered impossible for a driver to close the main switch when the controller is off the neutral position.

Figs. 3, 4 and 5 show, in different positions, one of the devices mounted in a box similar to a driver's seat in the rough, the photographs being taken from the front. The driver sits at the left side of the box—that is, at the right of the picture—and operates the controller B, with his left hand. The rheostat selector shaft A, to which the controller B is attached, also carries a sector C, which prevents the main switch being closed except when the controller and all the selectors are at the neutral point. The switch handle, which is connected with a lever D, is also provided with a pawl E, which, to fully close the switch, must first pass through the slot in the sector. Should the controller be in any other position than neutral, the pawl and slot no longer coincide, so preventing the switch being closed. The arrangement does not prevent the current from being switched off at any position, as, the pawl being held forward by a pressure spring, the switch lever can be dropped at any moment, and independently of the controller.

The arrangement, which is quite simple and inexpensive, should be the means of preventing many an accident, especially having regard to the fact, mentioned above, that it can be freely adopted by any user or maker of electric motor vehicles.

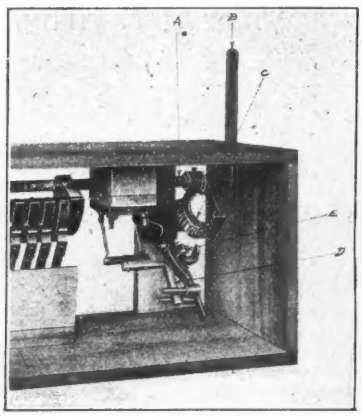


Fig. 3.—Controller in Neutral and Current Switch in Off Position.

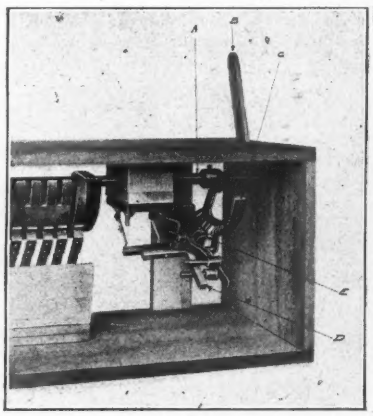


Fig. 4.—Controller in a Speed Position; Current Switch Blocked.

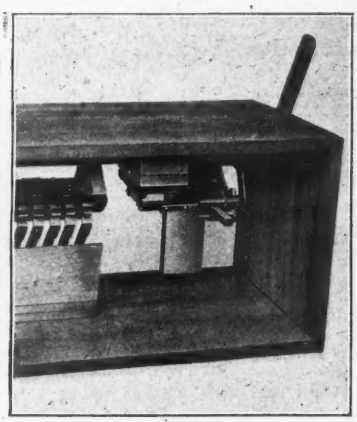


Fig. 5.—Switch properly Closed; Controller Moved into Speed Position.

Austin Field-Workshop Electric Generating Plant.

In a recent issue we briefly described the compact little electricity generating set which the Austin Motor Co., Ltd., of Northfield, Birmingham, have constructed in large numbers for supplying current for X-ray apparatus in travelling operating theatres, while this week we are able to illustrate a plant they have recently designed for the special purpose of generating current for electric lighting and power purposes for field workshops.

The set consists of one of the standard-type Austin engines, with four separate cylinders coupled direct to an 18-kw. generator. The engine, which is provided with a governor in order to secure a constant speed, is fitted with magneto ignition, and is adapted to work with either petrol or paraffin; the former is used on starting up, and paraffin when the engine becomes warm, the heat of the exhaust manifold being utilised by means of a "muff" in conjunction with the gas admission pipe, to assist in the vaporisation of the heavy oil. An interesting feature of the plant is the method of cooling the cylinders; in place of the large tank of water usually employed for this purpose in stationary engines, an ordinary motor-car type radiator is employed, this being mounted on a separate bedplate and fitted with an enclosed fan driven by a small electric motor in order to maintain a strong current of cool air through the tubes of the radiator; flexible armoured hose is used to conduct the water from the engine cylinder to the radiator and *vice versa*, the circulation being assisted by means of a small pump. As will be seen in fig. 6, the set practically comprises four units—the engine and dynamo, the radiator and fan, and the paraffin and petrol tanks, the latter being mounted on stands in order to give the necessary flow of the liquid fuel to the carburetter, an arrangement which enables the plant to be quickly set up in any desired position.

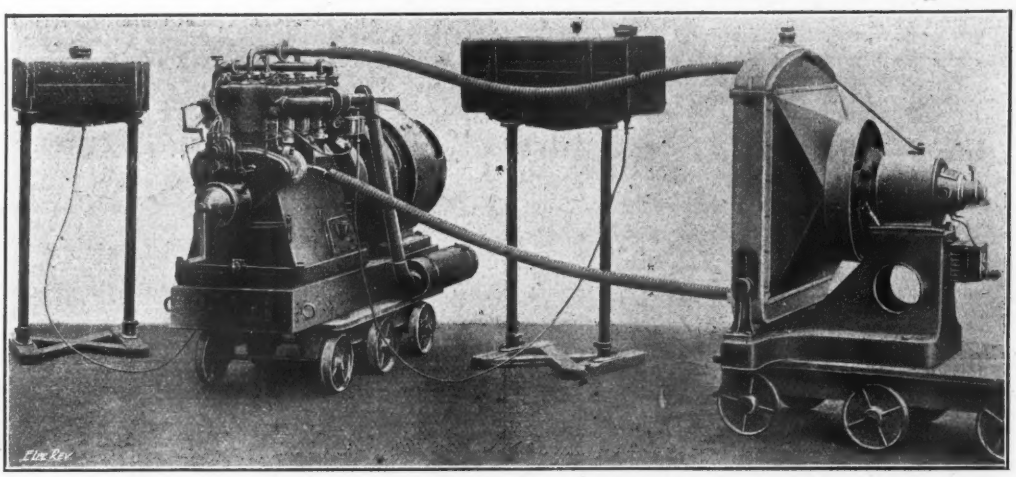


Fig. 6.—Austin Field-Workshop Electric Generating Plant.

Rochdale.—Having regard to the abnormal conditions of working and the rapid increase of the requirements of existing consumers, the Electricity Committee has decided that it cannot recommend the connection of any further large consumers at present. Mr. S. L. Pearce is to report upon the provision at the existing works to meet the increasing demand for energy, and to advise as to the charges for the supply of electricity for power purposes.

LEGAL.

Krupp's Patents for Magnetic Separators.

In the Patents Court, on Friday last, before the Controller, Mr. Temple Franks, and the Deputy Controller, Sir Cornelius Dalton, the Rapid Magnetting Machine Co., Ltd., applied for a licence to use three of Krupp's patents for a magnetic separator for treating ores. The patents are Nos. 14,082, of 1908, and 29,230, of 1911, in the name of Georg Ullrich, and 4,595, of 1913, in the name of the Fried. Krupp Aktiengesellschaft Grusonwerk.

The patents cover a device for extracting from amid the material in which it is found wolfram, the ore from which tungsten is derived. Wolfram is mined largely in the Cornish mines in combination with tin, and was at one time regarded merely as an impurity presenting considerable trouble to tin smelters. The material being feebly magnetic is susceptible of high intensity magnetic treatment through an apparatus to which the patents apply.

Mr. Hunter Gray appeared for the applicants; Sir George Croydon Marks, M.P., for Messrs. Edgar Allen & Co., Sheffield, who opposed the application, and Mr. Rushen, of the firm of Messrs. Haseltine, Lake & Co., for the patentees.

Mr. Hunter Gray said he supposed Messrs. Edgar Allen & Co. also proposed applying for these patents.

Sir George intimated that he intended applying for a dozen patents in connection with this machine at a future date, and he did not know how the Rapid Magnetting Machine Co. thought they could get on with only three. They were already manufacturing to the order of the Government.

Mr. Gray went on to say that the applicants were incorporated in 1903, a British company with British capital, and were the only firm in the British Empire that specialised in magnetic separators. The principle of the machine applied for was that of a number of magnet poles placed in a ring over which rotated a disk-shaped magnetisable body. The electromagnets below, with attached pole-pieces, were excited by coils, and a rotating shaft, to which the upper ring or disk-shaped armature was attached, ran through the centre of the circular iron body which carried the magnets. Between the magnets and the armature rotating above them, the material, from which the metal was to be drawn, was fed in from a hopper. Round the under side of the revolving piece went concentric magnetisable, axially-adjustable rings, wedge-shaped below, at graduated distances from the magnets. The outermost ring-edge was the furthest away from the horizontal pole surfaces, and therefore produced the weakest zone in the magnetic field. This attracted particles of the highest permeability, whereas the inner ring-edge was nearest the pole surfaces, produced the strongest zone, and consequently attracted substances of lower permeability. Thus the material was graded. Midway between the magnets, the attracted particles fell off the rings, the place of minimum magnetic intensity having been reached, and were carried away in different directions in their separated and graded form.

In the 1911 patent the armature-rings, as they were called, were fixed and the field below was fixed, and there was a curious zig-zag-shaped trough running from the centre, through which the ore travelled. It was this trough now that revolved. The result was that the ore did not "stick," but it was carried away equally in graded sizes. It was an adjustment of the same principle and an improvement, and it was called the dry treatment. There was a further modification, known as the wet treatment, where water was played upon the points of the wedge-shaped rings, to drive off the ore as it got out of the field.

Sir George: Mr. Thompson, who will give evidence directly, has written a letter, which has appeared in the technical journals, casting doubt on the special value of this machine; why, then, does he come here and ask you to give him a licence to make it?

Mr. Gray: Because the public want it—misguidedly and foolishly they want it—and his firm have more experience than any other for making and selling it. They suggest the usual royalty of 5 per cent. on the selling price, and will give an undertaking that the price at which they sell shall be, at most, not more than the price charged by the patentees before the war.

Mr. H. Huband Thompson, the applicants' managing director, giving evidence, said magnetic separators had been the exclusive business of the Rapid Magnetting Machine Co., Ltd. Sir George Marks was wrong if he suggested that he ridiculed the German machine.

Sir George Marks: If Messrs. Edgar Allen & Co. may have a licence for a 5 per cent. royalty, too, that will simplify matters considerably. We are prepared to develop the sale.

The Controller said that as far as he was concerned both applicant firms should have a licence.

Mr. Thompson said that it was an extraordinary thing that the Government had not a British magnetic separator at the Imperial College of Science at South Kensington.

The Controller: The old story one hears here from time to time—no trouble taken by the British manufacturers to push their inventions.

Mr. Rushen, on behalf of the patentees, desired an adjournment to bring into the Court Mr. Walter Sully, whose wife's daughter was the inventor Ullrich's wife, to say he had practically concluded arrangements, when the war broke out, for erecting a manufactory for the supply of these machines in this country. He was to have paid a royalty of 30 per cent.

The Controller said he thought the application satisfactory. The only question was the royalty, and he should hear more about that next week. In the public interest he thought it advisable that the machines should be made in this country, and clients' letters which he had seen showed the estimation in which it was held. The applicants desired to say: "We can supply an efficient British designed machine, but if any customer is unpatriotic enough to require another type we can give him it." Their position was quite intelligible. The machine must be made in this country to meet the demands, and that being the position, he thought the Rapid Magnetting Machine Co., Ltd., should have their licence.

Munitions Appeal Case.

In the King's Bench Division, on April 7th, Mr. Justice Atkin heard an appeal by a firm of micanite and insulator makers from the decision of a Munitions Tribunal that they were not an engineering firm within the meaning of the Munitions of War Act, and therefore it was unnecessary for an employé to have a certificate on leaving their employ.

Mr. Alex. Nielson, appearing on behalf of the appellants, said that they were the makers of insulators and insulating materials for dynamos, &c., and much of their work was for Government contracts. During the last day or two workers in that trade had been put in the exempted list, and skilled men in the Army had been fetched back. The appellants' works were the only works of any substance to make micanite in this country, and he argued that this brought them under the definition of munition works.

Mr. Comyns Carr appeared for the Ministry of Munitions. Evidence was called.

In his judgment, his Lordship said the finding of the Tribunal was that the appellants' business did not consist wholly or mainly of engineering, and therefore a leaving certificate was not necessary. But the appellants had tendered evidence to indicate that their business was of a wide and different kind, and he was satisfied from that that they were engaged exclusively in making by means of machinery, articles which were the necessary parts of dynamos and other machines which were used for war purposes and for the production of power. Under those circumstances the question arose whether it was right or wrong to find that they were not engaged in engineering. The meaning of the word "engineering" had to be read in connection with the definition of munitions works in the Act. That definition applied to a factory or workshop engaged in manufacturing arms, and explosives, the repair of arms, naval and military buildings, and the supply of light, heat, water and power to such buildings. Having regard to this he came to the conclusion that the finding of the Tribunal was incorrect, and that their decision must be set aside. The appeal was brought purely for the purpose of obtaining a decision as to their actual position, and was, therefore, a test case.

Coal Mines Act: Prosecution.

At Merthyr, last Friday, the hearing was resumed of the summonses against Mr. W. W. Green, agent, and Mr. H. Thomas, manager, of Hill's Plymouth Co.'s Collieries, for offences under the Coal Mines Regulation Act, namely, failing to keep the plant in proper condition. After evidence had been heard respecting a length of bare cable, Mr. Vachell, for the Home Office, dealt with the charges of failing to earth a switch, instrument cover, and lampholder. He said that they were simply types of a number of offences of a similar character. Mr. H. Thomas, the manager, said he was under the impression all the parts mentioned had been earthed. It was the electrician's work to see that the earthing was done. He did not think Mr. W. J. Charlton, one of the inspectors, pointed out 170 unearthed pieces of apparatus, though he might have pointed out 90 unearthed lampholders.

According to the *Western Mail*, the next summons was that "the switchgear and all terminals, cable ends, cable joints, and connections of apparatus, had not been constructed and installed so that all live parts should be so protected or enclosed as to prevent accidental contact by persons and danger from arcs or short circuits, fire, or water."

Evidence was given by Mr. Charlton that there was a place in the colliery where there was no switch, and also no automatic means for cutting off the electrical pressure. At this place there were five lamps, and Rees Thomas, electrician, who was called for the defence, said these were only temporary lights, and the matter had been overlooked.

Giving evidence in support of the summons, "Cables not protected by metallic covering where pressure exceeds low pressure," Mr. Charlton said that at the No. 2 Pit he found a space of 4½ ft. where there was no metallic protection for the cable, and evidence was also given in support of the summons that unarmoured cables were not hung on proper insulators.

The hearing was adjourned.

Patents and Alien Enemies.—Application has been made to the Board of Trade by Messrs. Edgar Allen & Co., Ltd., Sheffield, for the avoidance or suspension of Patents No. 14,082/08, granted to Ullrich; and Nos. 17,459/09, 29,201/11, 29,224/11, 29,230/11, 4,595/13, 14,426/13, 14,427/13, and 24,355/13, granted to Fried. Krupp, A.-G. Grusonwerk.

Japanese Electric Wire Exports.—One result of the war is seen in the development of the Japanese export trade in insulated electric wire; a return was recently issued showing that the shipments from that country during the 11 months ending with November last attained a value of £80,500, as compared with only £31,600 in the corresponding period of 1914.

BUSINESS NOTES.

Catalogues and Lists.—Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Sixteen-page pamphlet containing illustrated particulars and prices of lanterns and reflectors suitable for industrial lighting. The types shown include enclosed lanterns for half-watt lamps, semi-indirect half-watt fittings for office and public interiors where glare would be objectionable. Several types of anti-Zeppelin reflectors, of which many thousands have been sold during the last few weeks, are shown, as well as a new concentrating reflector specially designed for workshop and office local lighting, and large reflectors for the larger types of half-watt lamps specially made for positions where it is proposed to replace arc lamps.

Reason Manufacturing Co., Ltd., Lewes Road, Brighton.—New catalogue, complete, with the exception of the street lighting fittings section, which will be ready shortly. The five sections now before us consist of a number of well illustrated leaflets filed in an expanding binder case. They deal respectively with electrolytic meters, maximum demand indicators, hand and electrically-wound time switches, fuse-boxes, current limiters, &c. In a number of cases dimensioned diagrams appear, and all prices are very boldly printed. Complete prices of the instruments are stated; as extras only such devices as are not necessary to the successful working of the various instruments are given.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 7,201 giving particulars and dimensions of small-power motors for A.C. and C.C.

Swedish General Electric, Ltd., London, W.C.—Three illustrated catalogues dealing respectively with split-phase motors, single-phase motors and A.C. fans of Century U.S.A. types.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LIV. April 1st, 1916. No. 258.—This issue contains the following papers:—"Continuous-current Railway Motors," by Mr. E. V. Pannell; "Application of Telephone Transmission Formulæ to Skin Effect Problems," by Prof. G. W. Howe; "Magnetic Behaviour of Iron at very High Frequencies," by Mr. N. W. McLachlan; "Duplex Balances on Long Submarine Cables," by Mr. W. Judd; "Notes on Electrical Work in Australasia," by Mr. C. J. Calman; and a Report on Insulating Oils.

"On the Relation of Imports to Exports." By Mr. J. Taylor Peddie. London: Longmans, Green & Co. Price 5s. net.

"Technological Papers of the Bureau of Standards." No. 62. "Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways." Washington: Government Printing Office.

"Quarantining Germany: A Common-sense Precaution." By P. J. Ford. Glasgow: J. Maclehose & Sons. Price 1d.

"Continuous-Current Engineering." By A. Hay. London: Constable & Co. Price 6s. 6d. net.

"The Dynamical Theory of Gases." (2nd edition). By J. H. Jeans. London: Cambridge University Press. Price 16s.

"Alternating Currents." By H. R. Kempe. London: Crosby Lockwood & Co. Price 3s. 6d. net.

Russian Trade Possibilities.—The *Electrical World* states that Mr. Marcus Stowe Hill, who recently returned from a seven months' stay in Europe as the representative of 18 large Middle West manufacturers, reports excellent trade possibilities for electrical goods in Russia. "The markets of the country, he said, are absolutely bare. The merchants are hungry for American goods, and American Consuls are flooded with inquiries as to where all kinds of manufactured articles can be purchased. Orders for great quantities of telephone and telegraph apparatus and for tons of wire are awaiting American manufacturers. There is an exceptionally strong demand for small motors from ½ H.P. to 4 H.P. Electrical equipment for demonstrating purposes in schools, X-ray apparatus, batteries and absolutely all kinds of electrical supplies are wanted in large quantities. Mr. Hill said that when he left Petrograd there was not a dry cell in the city to be purchased, and he repeats that the market shelves are practically bare of everything. Between 125,000 and 150,000 resident German merchants and manufacturers have been sent to Siberia, and the Russians are anxious that Americans should take their place. They are offering to provide three-fifths of the required capital investment if Americans will furnish the other two-fifths and the brains to establish American manufacturing plants in Russia. Mr. Hill has been working in Russia on a basis of sales direct from manufacturers to dealers, eliminating the commission system, under which Russia has been greatly handicapped. In the purchase of manufactured articles at the present time it is not so much a matter of price as it is one of getting the goods, for the prices being quoted by American manufacturers, while very substantial, are nevertheless considerably under what the German merchants, acting as jobbers in Russia, have heretofore charged for the same articles. The Russian credit, Mr. Hill said, is not only unquestionable but there is a great abundance of ready cash in the country, more so at this time than ever before. This is on account of the fact that the use of vodka has been abolished.

"American manufacturers have, he stated, a great advantage over British manufacturers in shipping goods to Russia in that the latter must make application to the War Office for permission to export. At the least, it is three months before they get a decision, and permission may then not be granted. American manufacturers thus receive a tremendous advantage on time of delivery, which is one of the very important considerations under present conditions. The Russians are prepared to pay the price because of the shipping difficulties, and they will furnish bankers' irrevocable confirmed credits with each order. Any firm contemplating granting a sole agency to a Russian is warned by Mr. Hill to investigate the standing of the individual very closely before so doing, to determine whether he intends to use this agency or to sell it. He says that a great many sole agencies are passed around from one man to another, none of whom knows anything about the business involved or cares to do so, since he only intends to sell the agency for $2,000 or $3,000 to the next man. Mr. Hill urges that no agency be granted until the reliability of the proposed agent has been positively established."

Machine Tool Association.—The annual report of the Machine Tool and Engineering Association shows a membership of 134. The matter of date of the next exhibition being dependent upon the coming of peace, cannot yet be settled definitely. "In view of the fact that the existing classifications of machine tools for Customs purposes is very imperfect, in consequence of which the Board of Trade returns are very misleading, representations have been made to the Board of Trade, and a promise has been given that the matter shall receive attention after the war, during which no alterations are being made to the classifications." "Negotiations have been opened with the British Electrical and Allied Manufacturers' Association with a view to the re-adjustment of certain trading practices as between machine tool makers and electrical manufacturers. While it is not possible to continue usefully the negotiations at present, it is proposed to resume them after the war. A recommendation was made to the members as to the attitude to be adopted to firms having connections, direct or indirect, with alien enemies."

Russian Trade Exhibitions.—A Reuter dispatch from Petrograd states that the Odessa branch of the Anglo-Russian Chamber of Commerce, with a view to the improvement of economic relations between Great Britain and Russia, has decided to open an exhibition of Russian goods in London, and an exhibition of British goods in Odessa.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Extensions.—At the Council meeting, last week, Mr. Ashworth moved that certain alterations and additions at the electricity works be referred back. He thought they ought to extend on a new site, and not spend money on the present works; he also urged the calling in of an expert. Ald. Higham explained that in going in for steam turbo-generators they were reverting to lines adopted by all the Councils in the country; they departed from orthodox lines when they went in for gas engines. With steam turbo-generators and the present lodge and a water tower, they would have sufficient capacity to deal with 4,000 kw. of plant. The amendment was lost.

Argentina.—A public electric light service has been inaugurated at Diamante (Entre Rios).

The Ministry of Finance has authorised the Direccion-General of the Port of Buenos Aires to arrange with the Compania Italo-Argentina de Electricidad for the suspension of the work of renewal of lighting material for a period of three years. This decision represents a saving of $23,000 gold per annum, so long as the arrangement subsists.

Bacup.—Bulk Supply.—The Rawtenstall Corporation has offered to continue the supply of energy to Bacup from the end of the first period of five years (August 2nd next), on existing terms, and the matter has been referred to a Sub-Committee. The Rawtenstall T.C. has also given notice that from the 1st inst. the basis price of coal for the purpose of charging large power consumers has been further advanced 1s. per ton.

Beckenham.—The Council has decided that in future the charge for electricity used at the various hospitals and hostels in the district shall be at the rate of 3d. per unit.

Birkenhead.—Loan Sanction Refused.—The L.G.B. has refused to sanction the borrowing of a loan of £6,400 for high-tension plant, mains, &c., on the ground that the extensions cannot be regarded as complying with the official stipulations.

Bolton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £2,281 for purposes of the electricity undertaking.

Bradford.—Plant Extensions, &c.—The Electricity Committee has come to an agreement with Messrs. Jeremiah Ambler & Sons, with reference to a bulk supply of electricity. The electrical engineer's estimate of the cost of extensions to the boiler house and cooling plant at Valley Road electricity works, now on order or in contemplation, amounts to £53,113. The L.G.B. has given formal sanctions to the borrowing of two sums of £20,102 and £6,814 respectively, parts of the above-mentioned sum of £53,113, and the Committee has decided to adopt the estimate, and to make application to the L.G.B. for sanction to the borrowing of £26,196, the balance of the sum of £53,113.

Carnarvon.—Proposed Loan.—Application has been made by the T.C. for sanction to a loan of £2,780 for a 100-kw. Diesel engine set, with fuel storage tanks, switchboard, &c., for the electricity works.

Continental.—Russia.—It is stated that, notwithstanding the war, the Russian Government is making preparations for an extensive utilisation of the watercourses of Finland for the generation of electricity for lighting and power purposes.

Italy.—In connection with the destruction of the Conti electricity works in the Val Brembana, it is reported in the *Rivista Tec. d'Elettricità*, that in consequence of the heavy snowfall an attempt was made to shut down the supply, but a short circuit occurred which resulted in the entire destruction of the plant, the loss being about a million lire.

Dartford.—Loan Application.—The U.D.C. has applied to the L.G.B. for sanction to borrow a loan of £1,000 excess expenditure on extensions to the E.L. station and plant, and to cancel £75 not spent in connection with an overhead cable.

Doncaster.—Electric Pumping Plant.—The Water Committee of the Council has had under consideration a report of the engineer regarding the existing plant in use for pumping river water, and at the last meeting it was proposed to abandon the present pumps and boiler, and to install electrical pumping plant capable of delivering water under pressure of 120 ft. head, at an estimated first cost of £300, and an annual cost of £340.

Dungannon.—Hospital Lighting.—The Co. Tyrone Tuberculosis Committee has decided to recommend the installation of an electric plant in the new sanatorium.

East Cowes.—Street Lighting.—The U.D.C. has accepted an offer by the Isle of Wight E.L. and Power Co. of a further allowance of 30s. per lamp for the lights to be dispensed with from April 1st to September 30th. The company had already reduced the charges for public lighting by one-half to 31s. 9d. per lamp per quarter.

India.—Street Lighting.—The Calcutta Electric Supply Corporation is pushing forward energetically the preparations for lighting Chowringhee with 900-c.p. half-watt lamps.

The electrification of the Bombay cotton mills is now nearly completed; motors of approximately 36,000 h.p. have been installed, divided amongst 26 mills, in addition to complete sub-station equipments for 30 cotton mills and two flour mills.—*Indian Textile Journal.*

Indian Engineering states that the Ootacamund Municipal Council has decided that the question of electrically lighting the town by suction-gas engine plant must stand over in consequence of the high price of the plant, and the probability that it might not be obtainable at all at present.

London.—Westminster.—The St. James's and Pall Mall Electric Light Co. has advised the City Council that it will be compelled from June 24th next, to charge for electricity for lighting purposes at 4d. per unit net. It is not proposed to increase the charge for power supply. The Contracts Committee has instructed the city engineer to report as to the practicability of substituting and using gas lighting, and the cost thereof, at those buildings now lighted by current supplied by the St. James's Co.

Battersea.—The Electricity Committee has been in negotiation with the Fulham B.C. with reference to the supply of electricity in bulk under the terms of the linking-up agreement. The electrical engineer reports that the test supply given by Fulham during January to March has been satisfactory, and the Committee is arranging for a continuance of this supply during the year ending March, 1917.

Manchester.—Loan Sanctions.—The L.G.B. has sanctioned the borrowing of £30,000, repayable within 15 years, for equipment of sub-stations, and £10,000, repayable within 10 years, for the provision of motors for hire.

The Education Committee has accepted an offer by the Electricity Committee with regard to the electric lighting of the Municipal School of Art extension.

Nelson.—New Plant.—The electrical engineer has been instructed to obtain estimates for a complete turbo-generator set.

Nuneaton.—Subject to satisfactory terms being arranged, the T.C. has decided to extend the mains to Weddington Hall Hospital. It is anticipated that other consumers will be secured *en route*.

Rathmines.—Street Lighting.—The Urban Council has decided that every alternate public electric lamp shall be left unlighted during the present financial year with a view to saving expense.

Rotherham.—New Plant.—The Electric Light Committee proposes to purchase an additional rotary converter to meet the demand from Tinsley, and has accepted an offer for the supply of such plant for £690, the money to be defrayed out of the renewals fund.

Scarborough.—Street Lighting.—The T.C. has instructed the Lighting Sub-Committee to consider the question of electric lighting in certain main streets after the war; the public gardens have been electrically lighted for some time, but the streets are entirely gas lighted.

South Africa.—A domestic water scheme and electric lighting installation has been completed at Pietersburg, and Mr. Curtis, late town engineer of Wimburg (O.F.S.), has been appointed engineer. Mr. H. Hancock, of Klerksdorp, acted as consulting engineer, and Mr. R. Turnbull Mawdesley acted as his representative on the construction works.

Stockton-on-Tees.—Year's Working.—The loss on the Corporation electricity undertaking for the past year amounted to £1,008, against £651, as estimated. Sales of current produced only £3,120, being about £680 short of the estimate, due to lighting restrictions, while for public lighting only £62 was received against the estimated £300. The total income was £9,509, instead of the estimated £10,325, the actual expenditure being £10,517, or £459 less than anticipated. For the current year a loss of £1,998 is estimated for; expenditure is estimated at £11,580, the large increase in the item being due to the purchase of electricity in bulk. The revenue is estimated at £80 more than that received last year.

Teignmouth.—The U.D.C. has decided not to object to the whole of the proposed electrical mains in Shaldon being overhead, subject to steel poles being used in certain streets, and to the proposed Shaldon Electric Lighting Co-operative Society entering into an agreement with the Council on similar terms to the agreement with Messrs. Purves, subject to such modifications as may be necessary.

Torquay.—During the past month 158,490 units were generated at the electricity works, an increase of 29,695 units as compared with the corresponding month last year. For the year 1915 the electricity undertaking shows a net profit of £1,200, which has been expended on services.

Wakefield.—Price Increase.—In view of the increased cost of generating electricity, the charges to power consumers are to be increased by 12½ per cent. and cash discounts are to be abolished.

U.S.A.—The Great Western Power Co. has carried out an extensive investigation into the possibilities of electro-chemical development in the Californian area which it serves, and a company has now been organised, to be known as the Great Western Electro-Chemical Co., which is to erect an initial installation on a 15-acre site at Pittsburg, Cal., to produce caustic soda and bleaching powder. The plant will be the first of the kind west of Detroit.

Walsall.—The Committee has decided to place certain sums received on the sale of superseded plant to a special account, to be utilised in repayment of the outstanding debt on plant.

Wigan.—In connection with the proposed supply of current to the premises of the Northern Coarse Spinners, Ltd., the Electricity Committee has decided to apply for permission to borrow £781 for cable, switchgear and a transformer. The motors and the electric lighting installation at the mill of the Coarse Spinners, Ltd., are being supplied by the Corlett Electrical Engineering Co., Ltd., Wigan. Mr. H. Dickinson, city electrical engineer, of Liverpool, is to report on the electricity undertaking for the fee of 150 guineas.

Wolverhampton.—Plant Extensions, Loans, &c.—The Electricity Committee reports that the continual demand for energy renders it necessary to make extensions to the generating station plant, in order to cope with the load during the winter of 1917. Having considered reports of the electrical engineer (Mr. S. T. Allen) upon the question, the Committee recommends the extending of the boiler house, at a cost of £17,160, made up as follows:—Building, £1,000; steel work, bunkers, &c., £2,200; two water-tube boilers (40,000 lb.), complete with mechanical stokers, £8,000; feed, steam and blow-off piping for boilers, £500; forced draught plant, £500; feed pump plant, £400; coal and ash-conveying plants, including ash-bunker, £2,500; erecting a steel chimney on foundations already provided, £500; contingencies, £1,560. The Committee further recommends that application be made for sanction to borrow the above-mentioned sum, and that it be authorised to invite and accept tenders for all necessary works. It is also proposed to make application for permission to borrow £6,600 for defraying expenditure to be incurred in connection with extensions to mains, foreshadowed in the report.

TRAMWAY and RAILWAY NOTES.

Bacup.—Consideration has been given to proposals from the Rawtenstall Corporation for alterations in the tramway fares, but the Electricity and Tramways Committee is unable to agree to the proposals, holding that the increases would be paid entirely by Bacup.

Burnley.—The Tramways Committee has considered the question of the financial position of the undertaking, and has decided that the charges for all privileged tickets shall be increased by 7½ per cent.

Bradford.—Year's Working.—The tramway manager has submitted a report showing the approximate result of the past year's work of the tramway undertaking. The estimated total receipts were £334,315, an increase of £14,921 as compared with the previous year; the total number of passengers carried was 74,000,000, an increase of 4,000,000 on the previous year's figures; wages £129 313, show an increase of £9,182, whilst the department had paid a sum of £7,102 in war bonus, and £7,352 to dependents of employés who had joined the Forces. There had been an increased consumption of electricity in connection with the tramways, notwithstanding the fact that the car mileage was less than a year ago—this being attributed to the larger loads, the severe weather conditions, and the absence of many old and skilled drivers. This increased consumption will involve an amount of something like £1,000 being charged against the undertaking. Last year's car mileage was 6,199,601, a decrease of 172,109 miles.

The Traffic and Fares Sub-Committee of the Tramways Committee of the Corporation has authorised the general manager (Mr. C. J. Spencer), to engage additional women conductors whenever male labour for the purpose is not obtainable. The tramway manager has received authority to equip an electric lorry, or to place an order for a suitable petrol chassis. In response to an instruction of the City Council for the Tramways Committee to report at the April meeting as to what it can do to deal equitably with all tramway fare stages in the city (including Great Horton), the Committee states that it will not be in a position to submit the desired report until the balance sheet has been prepared.

Continental. — Spain. — The Sociedad de Tranvia Urbano de Bilbao has applied for a concession to construct and work an extension to the existing tramway system in the town of Bilbao to the Barrio de Irali Barri.

Croydon.—Strike.—A strike occurred on Saturday morning last among the drivers and conductors on the South Metropolitan Tramway Co.'s system running to Sutton, Tooting, Penge, &c., owing to two women receiving instruction in driving for test purposes. A restricted service was maintained over the week-end, the Tooting route being closed.

Later information shows that the strike has spread to the employés of the Croydon Corporation tramways—who demand concessions in regard to wages and hours—and a reduced service is being given on the Corporation lines. The Croydon authorities state that the increase in wages, and other concessions in their case, would cost £10,000 a year, and would equal a 2½d. rate on the town. The B. of T. intervened in the dispute on Tuesday, without result, and there appears to be a prospect of the strike spreading.

Doncaster.—At a meeting of the T.C. last week, at which the local rates were reduced by 4d., satisfaction was expressed at the success of the new Woodlands tramway route. In five weeks 23,006 passengers have been carried, and it was stated that a reduction of fares on the route was under consideration.

Edinburgh.—The Tramways Committee has reported against any immediate decision to adopt electric traction on the tramways when taken over; the burgh engineer is to report on the matter at a later date. Councillor Allan has a motion before the Council urging the adoption of some form of electric traction when the company's lease expires.

Gateshead-on-Tyne.—The Town Improvement Committee has received a letter which has been sent to the Gateshead and District Tramways Co. by the B. of T., with reference to the accident on Bensham Bank, in which Lieut.-Colonel Von Donop, R.E., calls attention to the fact that a slight change in the position of Ravensworth loop would provide a better gradient for cars to stand on, and, further, recommends that motormen should not leave their cars during the journey. The Committee has written to the company, inquiring what action it was proposed to take, and the company has intimated its willingness to carry out the suggestions. The matter was left in the hands of the Town Improvement Committee with full power to act.

Halifax.—Year's Working.—The financial statement of the borough treasurer shows that the total income of the Corporation tramways during the past year has been £113,492 (12·404d. per car-mile), whilst the expenditure has totalled £95,486 (10·436d. per car-mile), leaving a profit of £18,006, as compared with £17,052 for the preceding year. The number of passengers carried showed an increase of 1,316,932 at 21,024,003.

Leeds.—From a statement which has been issued by the tramway department it appears that the receipts for the year ending March 31st last (£475,661) show an increase of £41,150, as compared with those of a year ago. There has been a decrease in the car-mileage (9,405,121) of 117,616 miles, due to inability to use the full stock of cars owing to enlistment of employés. The number of passengers carried showed an increase of 7,814,533 at 103,453,801. The receipts per car-mile (12·138d.) increased by 1·187d.

London.—Kensington.—The B.C. has been recommended to raise no objection to the proposal of the M.E.T., Ltd., to use trailer cars, on the understanding that such consent is for the period of the war only.

Oldham.—Year's Working.—The returns of the tramway department up to March 25th show, subject to audit, a profit of £3,985. On the Hollinwood extension £1,000 has been expended, and allowances to employés with the Colours have amounted to £5,225. Ald. Isherwood told his Committee, on April 6th, that the result was as good as the Committee had ever had.

Rochdale.—Tramway Lease.—The Tramways Committee has intimated that it cannot accept the draft lease of the Milnrow tramways as returned and altered by the Milnrow D.C., and further suggests that the matter might be postponed until after the war.

During the last year the total receipts of the tramway department amounted to £82,836, an increase of £4,477. The passengers carried numbered 13,705,871, an increase of 298,553.

Rotherham.—Rolling Stock Purchase.—The Tramways Committee has recommended the Corporation to exercise its option to purchase the additional 11 bogie tramcars from the Oldham Corporation. Repairs are to be carried out during the month to various parts of the tramway track.

Stockport.—The Tramways Committee has decided to accept the offer of £600, made by the General Electric Construction Co., Ltd., for one of the Corporation's railless trolley-buses.

Swansea.—Overhead Breakdowns.—The electrical engineer has reported on the number of breakdowns of overhead equipment on the Morriston section of the Corporation tramways during the past three months. He stated that practically all breakdowns were due to falling of guard wires. The tramway engineer reported that the steel guard wires originally installed had corroded to such an extent that the Tramway Co. had decided to replace them on a section of about six miles with bronze wire.

Swinton and Pendlebury.—Tramway Lease.—The U.D.C. has, subject to the approval of the B. of T., decided to lease the tramways to the Salford Town Council for 21 years from January 1st, 1905.

Warrington.—The free use of the tramway cars and municipal omnibuses by soldiers, other than wounded soldiers in hospital dress, is to be withdrawn, because the privilege has been abused.

TELEGRAPH and TELEPHONE NOTES.

France.—The French Government has drawn up a Bill to be presented to Parliament, providing for an outlay of over 120,000,000 fr. for the improvement and extension of the telephone system of Paris. A technical Commission has been appointed, and has handed in its report. The chief provisions of the proposed scheme are as follows:—The construction and equipment of six large new telephone exchanges in Paris; the enlargement of three existing telephone exchanges; the introduction of new multiple switchboards for 12,600 lines; the installation of automatic meters in the Paris exchanges; and the laying down of long-distance subterranean lines.

The Telephone System.—Last month the laying of an underground cable between London and Liverpool was completed. Considerable progress has been made in restoring the overhead telephone lines brought down in the storm. Of 600 lines going out of London which were down, 370 had already been repaired by last week-end. Just after the storm there were from 40 to 60 important places in the country to which it was impossible to get through from London; on Saturday the number had been reduced to four.—*The Times.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—April 19th. U.D.C. Twelve months' supply of lubricating and other oils, for the Electricity and Tramways Department. See "Official Notices" to-day.

Australia.—Sydney.—May 24th. N.S.W. Government Railways and Tramways. 16/600-volt D.C. motors for tramway stores, Randwick.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 1st. City Council. Meters and maximum-demand indicators. See "Official Notices" April 7th.

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

May 17th. Victorian Government Railways. One 2-ton electrically-operated goods elevator for Jolimont car-shed.*

Manchester.—April 17th. B. of G. Electrical materials for Withington Institution in connection with the additional electric lighting of the main side of the establishment. Particulars from the acting master at the Institution, Nell Lane, West Didsbury, Manchester.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

North Africa.—May 30th. Sixty years' electric tramway concession for Melilla; work to be completed in two years. Tenders to Direccion General de Obras Publicas, Ministerio de Fomento, Madrid. The *Board of Trade Journal* contains some further particulars.

Salford.—April 17th. Electricity Committee. Switchgear for 5,000-KW. sub-station equipment. See "Official Notices" April 7th.

Walthamstow.—April 26th. U.D.C. Water-softening plant for the Electricity Department. See "Official Notices" April 7th.

Warrington.—April 26th. Electricity and Tramways Committee. Boiler plant and economiser. See "Official Notices" April 7th.

West Hartlepool.—April 28th. Electricity Department. Two water-tube boilers with superheaters and mechanical stokers. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Belfast.—Messrs. Venner Time Switches, Ltd., have received a contract from Belfast Corporation for automatic time switches for a year.

Bradford.—The Electricity Committee has accepted the tender of Messrs. Haywards, Ltd., for glass flooring, and that of Messrs. Redpath, Brown & Co., Ltd., for constructional steelwork required at the Valley Road electricity works; also offers for plant for the Valley Road works as follows:—

Musgrave & Co., Ltd.—Induced-draught plant and two steel chimneys.
Electromotors, Ltd.—Three 60-B.H.P. pipe-ventilated fan motors.
Ferranti, Ltd.—Two 250-K.V.A. transformers.

Burton-on-Trent.—T.C. Jonathan Longbotham and Sons are to supply 4,000 tons of coal to the Lighting Department.

Gillingham (Kent).—T.C. Coal for the electricity works:—

Household screenings, Gillingham Co-operative Society, 20s. per ton; ditto, Anderson, Cornelius & Snow, Ltd., 20s. 6d. per ton; 200 tons Baddesley 1½-in. nutty slack, Clewes & Co., 26s. 8d. per ton; Welsh coal, J. Gill & Son, 30s. 9d. per ton.

Gloucester.—T.C. Tramway points and crossings: Edgar Allen & Co., Ltd., £2,500.

London.—Hammersmith.—The Electricity Committee recommends the acceptance of the offer by Messrs. Cory Bros. to supply 100 tons weekly for six months of Aberclwyd coal, at 23s. 6d. per ton.

Meter Contracts.—Messrs. Chamberlain & Hookham, Ltd., have received contracts for electricity meters for the ensuing 12 months from Pembroke, Walthamstow and Bermondsey.

The Electrical Apparatus Co., Ltd., has received a contract for a year's supply of electricity meters for the borough of Basingstoke.

Nuneaton.—T.C. Coal for the electricity works for a year:—

Haunchwood smudge (1,000 tons), Wm. Jeffcoate, Ltd., 9s. 6d. per ton; Ansley Hall smudge (1,500 tons), Mr. Geo. Smith, 9s. 6d. per ton.

Sheffield.—City Council. The following tenders are recommended for acceptance:—

W. Marlow & Sons, Ltd.—Erection of electricity sub-stations: Sidney Street, £1,011; Stanley Street, £1,216.
Mortimore, Lyon & Co.—Increasing efficiency of the six-cell unit at Lumley Street destructor by 75 per cent., £1,029.
Edison Accumulators, Ltd.—Three-ton wagon, £1,200; two-ton wagon, £1,000.

Sunderland.—The T.C. on Wednesday accepted the following tenders:—

Babcock & Wilcox.—Superheater tubes.
G. & J. Weir.—Impellers for boiler feed pumps.
I.R., G.P. & Telegraph Works, Ltd.—Insulating tape.
Dussek Bitumen Co.—Box compound.
W. Simpson.—Hand-carts.

Swansea.—Council. Ferranti, Ltd., at £66, for a three-phase transformer for supplying a new school.

Wimbledon.—The Electricity Committee considers it undesirable to enter into contracts for supplies during the ensuing year. The borough electrical engineer has obtained offers from certain firms for the supply of various goods and materials, which the Committee recommends for acceptance, and also that the remainder of the supplies required should be purchased as and when required at the lowest prices obtainable.

Wolverhampton.—The Electricity Committee recommends the T.C. to accept the following tenders:—

Brush Electrical Engineering Co.—Two 300-KW. transformers, £399 10s.
Reyrolle & Co.—Switchgear, £796.
Stirling Boiler Co.—Two Stirling boilers, two super-heaters, and two sets of mechanical stokers, £8,222.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, April 14th. At 6 p.m. At Great George Street, S.W. Paper on "Theory and Practice in the Filtration of Water," by Mr. W. Clemence.

Physical Society of London.—Friday, April 14th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Variation of Resistance with voltage at a Rectifying Contact of two solid conductors with applications to the Electric Wave Detector," by Mr. D. Owen; and "The Electrical Capacity of a Gold-leaf Electroscope," by Mr. T. Barratt.

Chief Technical Assistants' Association.—Saturday, April 15th. At 3 p.m. At the Tavistock Hotel. Discussion on "The Advantages and Disadvantages of Various Systems of Laying Mains."

Royal Institution of Great Britain.—Friday, April 14th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Genesis and Absorption of X-rays," by Prof. Sir J. J. Thomson.
Saturday, April 15th. At 3 p.m. At Albemarle Street, W. Lecture (VI) on "Radiation from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Institution of Civil Engineers.—Tuesday, April 18th. At 5.30 p.m. At Great George Street, S.W. Annual general meeting.

Post Office Telephone and Telegraph Society of London.—Tuesday, April 18th. At 6.30 p.m. At the I.E.E., Victoria Embankment. Paper on "Telegraph Tariffs and Economic Needs," by Mr. J. Lee.

NOTES.

Easter Holidays.—Owing to the Easter Holidays, the Electrical Review for Friday, April 21st, will be published on Wednesday, April 19th. All matter for both the editorial and advertisement pages for that issue should be in our hands at the earliest possible moment. A notice regarding the latest times for advertisements to be received, appears in our advertisement pages to-day.

Foreign Trade.—The March Figures.—The following are the electrical and machinery figures given in the official returns for March:—

	Month of March.	*Inc. or dec.*	*Inc. or dec. to date compared with 1915.*
Imports.			
Electrical goods and apparatus, excluding machinery and uninsulated wire... ...	£115,409	+ £47,783	+ £137,236
Machinery	685,507	+ 103,419	+ 225,891
Exports.			
Electrical goods and apparatus, excluding machinery and uninsulated wire	328,173	+ 51,203	+ 186,011
Machinery	1,424,140	− 166,294	− 110,860

Gas v. Electricity.—An Indian contemporary quotes a recent article in the American *Gas Age*, which sums up the results of an investigation as follows:—"It can be said that there is no question but that gas lighting stands behind electric lighting in every respect, for the latter causes no vitiation of the air, develops no humidity and moisture and produces little heat." It appears from the results of experiments that the claims for superior ventilating effect of gas are unfounded. The tests made were various, one of these being the cooking of sauerkraut in the room, and then observing how long the odour could be detected in the room. There was no difference in the room lighted by gas or electricity. Tests for CO_2 showed a higher percentage for gas, and two curves illustrating the decrease of bacteria in the air, when subjected for a definite time to gas or electric lighting, showed little difference.

Vacuum-Fused Silicon Iron.—In the *Bulletin* of the American Institute of Mining Engineers, Mr. T. D. Yensen, of the University of Illinois, has given the results of his experiments on vacuum-fused iron containing varying percentages of silicon. The experiments were made in an attempt to improve the iron used in dynamo-electrical machinery. The qualities desired were low hysteresis loss, high electrical resistivity (to reduce eddy-current loss), and high permeability. Previous experiments by the author had shown that pure electrolytic iron, melted and cooled in vacuo, possessed desirable properties in respect of high permeability (about twice that of the best commercial iron) and low hysteresis loss. If the electrical resistivity of this iron, which in the pure state is very low, could be increased without impairing its magnetic properties, an excellent iron for electromagnetic purposes would be produced. Previous experiments by Prof. C. F. Burgess, at the University of Wisconsin, had shown that when melted in an atmosphere of carbon monoxide at ordinary pressures, pure iron absorbed about 0·1 per cent. carbon, and probably some oxygen, as the electric resistance increased more than would be expected from the carbon alone. The iron used in the present experiments was doubly refined electrolytic iron deposited from Swedish charcoal iron, according to the methods of Burgess. The refined iron had the following composition:—Carbon, 0·006 to 0·01 per cent; silicon, 0·01 per cent.; sulphur, trace; iron (by difference), 99·98 per cent. Previous experiments by the author had shown that carbon and boron, when alloyed with this vacuum-fused iron, lowered the magnetic quality, and they were thus undesirable where high permeability and low hysteresis were needed. The present experiments with silicon gave opposite results, and seem to have produced

an iron which possesses very remarkable properties, highly desirable in iron for electrical machinery.

The maximum tensile strength of 105,000 lb. per sq. in. (73·5 kg. per sq. mm.) occurs with a silicon content of 4·5 per cent.

With regard to the magnetic properties, the best alloys are obtained with about 0·15 per cent. and 3·40 per cent. silicon after annealing at 1,100° C. The maximum permeability for both of these alloys is above 50,000, and the hysteresis loss for B_{max} = 10,000 and 15,000 is about 300 and 1,000 ergs per cb. cm. per cycle respectively. This hysteresis loss is ¼ and ⅓ of the corresponding loss for commercial silicon steel. The most favourable annealing temperature is in every case 1,100° C.

The specific electrical resistance increases about 13 microhms for the first per cent. silicon added. For each additional per cent. added the increase is about 11 microhms. Consequently, the 3·40 per cent. alloy mentioned above has a resistance more than four times that of the 0·15 per cent. alloy.

By the vacuum process two silicon alloys have thus been produced that have very valuable characteristics: one low in silicon, not very strong, but extremely ductile, of high permeability, low hysteresis loss, and low electrical resistance; the other high in silicon, very strong, moderately tough, of high permeability, low hysteresis loss, and high electrical resistance. The properties of these alloys are summarised in the table below. The first is evidently suitable for use in places where high permeability and low hysteresis loss are the chief requirements, while the second alloy is suitable for electromagnetic machinery, principally transformers, where a low eddy-current loss is an additional requirement.

Properties of the Two Best Iron-Silicon Vacuum Alloys.

Silicon content per cent.	Stress at yield point, lb. per sq. in.	Ultimate strength, lb. per sq. in.	Elongation, per cent.	Reduction of area, per cent.	Maximum permeability.	Density for max. permeability, gausses.	Hysteresis loss, ergs/c.c./cycle. For B_{max} = 10,000	Hysteresis loss, ergs/c.c./cycle. For B_{max} = 15,000	Spec. Elect. Resistance, microhms.
0·15	18,500	37,000	56	90·0	Above 50,000	6,500	288*	916†	11·8
3·40	58,000	76,500	21	28·5	Above 50,000	6,500	280*	1,025†	48·5

* From data recently obtained with rings these values may be 10 per cent. to 20 per cent. low.
† From data recently obtained with rings these values may be 5 per cent. to 10 per cent. high.

—*Met. and Chem. Eng.*

Institution and Lecture Notes.—Institution of Electrical Engineers.—The annual general meeting of the Institution will be held on Thursday, May 11th, at 8 p.m., to receive and consider the accounts for the year ended December 31st, 1915, and the annual report of the Council, and to elect two auditors.

In view of the Government restrictions with regard to the supply of paper, and also owing to the great increase in its cost, the Council has decided to reduce the amount of matter in the *Journal*, and to publish it monthly, instead of fortnightly, until conditions are again normal.

At the meeting of the Yorkshire Local Section on Wednesday last, a paper was read by Mr. George Wilkinson on "Electric Heating: Its Present Position and Future Development."

Iron and Steel Institute.—The annual meeting will be held on May 4th and 5th, at the Institution of Civil Engineers. After the presentation of the Bessemer Gold Medal to Mr. F. W. Harbord, F.I.C., and the delivery of the inaugural address of the President, Sir W. Beardmore, a number of papers will be read, including one by C. Benedicks, Ph.D., on "A New Thermo-Electric Method of Studying Allotropic Changes in Iron or other Metals." The following new by-laws, as already proposed and amended, will be formally moved and voted upon during the proceedings:—

1. In the event of a state of war existing between the United Kingdom and any other country or State, all members, honorary members, and honorary vice-presidents who shall be subjects of such enemy country, or State, shall forthwith cease to be members, honorary members, or honorary vice-presidents of the Institute, but they shall be eligible for re-election after the war in the usual manner.
2. The Council shall have absolute power to remove from the list of members of the Institute the name of any member, whether ordinary or honorary, for wilful contravention of the by-laws or for any other reason which seems to them sufficient, and such ordinary or honorary member shall thereupon cease to be a member of the Institute.

The autumn meeting will take place in the same building on September 21st and 22nd.

Electrical Association of Australia.—Recently in a paper read before the N.S.W. Section, Mr. Wm. Corin, chief electrical engineer of the N.S.W. Public Works Department, read a paper on the "Power Requirements and Resources of N.S.W.," attention being particularly given to the applications of electricity. The H.P. of various types of stationary industrial prime movers in use in 1913: was steam, 67,045; gas, 12,294; water, 77; oil, 1.142 (total non-electric, 80,558 H.P.); electric, 35,885 H.P., excluding electrical power stations. At the beginning of the century the H.P. supplied by other forms of prime mover was 112 times that supplied by electric motors, in 1913 the ratio had been reduced to 2¼ times; the electric motor curve shows an accelerating upward tendency, while the non-electric curve indicates retardation in the rate of increase. He anticipates that in the next 15 years stationary industrial purposes will require 381,000 H.P. additional to 1913, *i.e.*, a total of 497,000 H.P., of which 416,000 H.P. may be anticipated to be electrical. He further estimates that this will require 300,000 Kw of plant and represent the use of 600 million units a year, and points out that anything up to half this amount may be required for electrochemical and electrothermic processes alone and the total may be largely increased. In 1913 there were in N.S.W. 113 townships of 1,000 inhabitants and upwards, with a total population of 350,000, and by 1930 he anticipates that there will be 170 such townships with half a million population. Assuming that these will demand an electric supply for lighting and small power uses, he estimates a further demand of 15,000,000 units a year and a maximum load of 15,000 Kw. If power were available on a comprehensive scale, a great impetus would be given to the use of power-using contrivances for all agricultural purposes. Mr. Corin considers that railways and tramways will require 185,000 Kw. additional, and suggests a total demand in 1930 for 700,000 Kw. or 1,860,000,000 units. He further deals with the coal and water-power resources of the State, mentioning that he is carrying out a systematic preliminary examination of the whole of the water-power resources.

The Chemical Society.—An extraordinary meeting of the Fellows is to be held on May 11th, to consider the question of removing from the list of members the names of nine alien enemies. In the annual report of the Council, presented to the Fellows on March 30th, it was stated that the Council, by a large majority, had decided that no steps should be taken in this direction until after the cessation of hostilities; but the meeting, by a large majority, repudiated this view, with the result above mentioned. The Fellows have not forgotten that the use of poisonous gas originated in Germany, and will for ever remain a foul stain on the fair fame of chemical science.

In an address to the Halifax, N.S., Commercial Club recently, a scheme to harness the Bay of Fundy tides for the development of hydro-electric power was outlined. The proposal is to install tidal motors in Minas Channel, where the flow is between 9 and 11 miles an hour, by means of which sea-water would be pumped up into reservoirs on the cliff top, subsequently being used to develop a steady output of electricity in a power house at sea level. A suitable type of tide motor has already been developed experimentally. The most suitable power site is at Cape Split, which is within 125 miles' distance of most of Prince Edward Island, and about 85 miles from Halifax. It is estimated that the scheme would render 2 million H.P. available.

Decimal Coinage and the Metric System.—The report of the Decimal Association for the past year, which was issued recently, draws attention to a distinct advance during the year in public (as differentiated from scientific) opinion in favour of the adoption of the decimal system of coinage and the metric system of weights and measures, especially in commercial circles. The severity of the handicap imposed upon our manufacturers by the use of two systems in the works and offices and by the complicated nature of the British system is emphasised, but it is pointed out as a hopeful feature of the situation that the war has familiarised our armies with the metric system, and after the violent changes which the nation has already experienced it is more ready than formerly to entertain proposals of reform. In November last the Association circularised the Chambers of Commerce of the United Kingdom, inviting them to induce their members to introduce the metric system into their own works, and received a favourable response, all the replies expressing complete agreement with the work of the Association. The use of metric equivalents of all British standards in parentheses in recent specifications issued by the Engineering Standards Committee is welcomed, and resolutions urging the general and immediate adoption of the metric system which were passed by the Council of the British Horological Institute and the Committee of the London Wholesale Jewellers' and Allied Trades' Association are recorded. The fact that last year no fewer than 38,373 metric weights and measures were submitted for testing in the City of London, as compared with 1,741 in 1914, to which we have already drawn attention, is quoted as a proof that the metric system is being more widely employed. The report further states that "the Electrical Review has been conducting an extremely useful canvass among electrical engineering firms in regard to the desirability of adopting the metric system in this country," and reproducing the series of questions which we addressed to manufacturers, expresses gratification at the fact that there was a majority of four to one in favour of the general adoption of decimal coinage and the metric system. A similar canvass instituted by Messrs. Richard Klinger & Co. amongst engineering and kindred trades produced a like result.

The diversity of the systems of weights and measures in use in Egypt has led the British Chamber of Commerce of Egypt to recommend the adoption of the metric system (which is already used in all Government Departments, public works, post offices, and railways). The coinage is already decimal, the Egyptian pound being divided into 100 piastres of 10 millièmes each (practically the system which we have recommended), and it is proposed by a very slight alteration to make the £E identical in value with the pound sterling. In January last the Second Pan-American Scientific Congress, sitting in Washington, U.S.A., passed a resolution urging the American Republics to adopt the metric system for all purposes. All the South American Republics already use it, and our trade with them is gravely prejudiced by our neglect to quote in the terms which their peoples understand. The income of the Association has suffered through the effect of the war, though a number of new supporters have joined it, and further support is urgently needed; the address of the Association is Finsbury Court, Finsbury Pavement, E.C.

With the report is issued a leaflet showing how decimal coinage can be adopted without altering the value of any of the gold and silver coins now in use in this country. The unit proposed is the

florin, the sovereign being the 10-florin piece; the florin would be divided into 100 cents, and new nickel coins, of the values of 10 cents (2½d.) and 5 cents (1½d.), would be introduced together with bronze coins denominated 4 cents, 2 cents and 1 cent, practically equal in value to the penny, halfpenny and farthing. In essence, the system is identical with that which we have recommended, for it retains the sovereign absolutely unchanged in value; whether the sovereign or its tenth part be regarded as the unit is purely a question of convenience.

At the spring meeting of the Lancashire, Cheshire, Cumberland, and Westmorland Division of the Incorporated Association of Head Masters, a resolution was passed urging head masters to emphasise the importance of the metric system, especially among boys who are leaving this year, and that special attention be devoted to practice in converting British into metric weights, measures, and coinage. A Sub-Committee was appointed to suggest ways of discovering and overcoming existing objections to the introduction of the metric system.

The *Indian Textile Journal* states that the Karachi Chamber of Commerce, in reply to Government, which invited its opinion on the reports of the Weights and Measures Committee, has replied that it is of opinion that any changes made should be in the direction of the decimal system.

The Electrification of Fibres.—The research which is about to be undertaken by the Leeds University into the causes of the electrification of fibres and fabrics during manufacturing processes will cover various classes of fibre, commencing with silk, as the phenomena are most readily produced with this material. Great interest is taken in the scheme by manufacturers, many of whom have offered their assistance. Hitherto the endeavour has been to cure the trouble; in the present research the fundamental causes will be sought with a view to preventing its occurrence. Wool, silk, cotton, and linen, says the *Yorkshire Observer*, all become electrified in the process of manufacture. The electrification of wool means that spinning from newly-made tops cannot be done satisfactorily. Sometimes tops have to be laid aside for at least a month before they are spun, and yarn is allowed to wait from 10 to 14 days before it is used. The tops of the yarn have to be put aside to allow the fibres to lose the electricity set up by the friction incidental to their manufacture.

Assuming a spinner to be producing 50,000 lb. of yarn per week, and the price to be 3s. a lb., the amount involved is £7,500. In the event of the reduction by a week of the time the yarn has to be allowed to lie to get rid of the electrification of the fibres, the saving to the spinner in interest alone would be about £30 a week. What this would mean throughout the textile industry cannot be comprehended except by the imagination of an exceedingly large sum of money. The importance of the forthcoming investigation will therefore be apparent. Attempts have been made, and with a considerable amount of success, to overcome the difficulty by the humidification of mills, and many mills are fitted with plant to humidify the atmosphere for this purpose. Humidification, however, is but a remedial measure after the electrification has taken place. The object of the research to be undertaken by Dr. Shorter is radical—an attempt is to be made to eliminate the electrification. Success in this direction will mean not only the saving in the direction already mentioned, but also the abolition of the expensive apparatus required by the humidification process, which has to be maintained and constantly kept in order.

The investigation to be undertaken is to be traced to two lectures delivered to the British Association of Mill Managers some years ago by Prof. W. H. Bragg, formerly of Leeds University.

Visits will be paid to works to investigate the electrification of silk, wool, cotton, and linen, and evidence will be gathered with respect to the effect on the electrification of fibres of the following conditions:—(*a*) Dry and wet weather; (*b*) east wind or south wind; (*c*) frost; (*d*) Monday morning—the effect of week-end rest, and the cooling and the drying of air. Steps will be taken to solve one fundamental point—namely, the question whether the difference between electrifiable and non-electrifiable specimens of the same species of fibre is a matter of electrical conductivity or surface structure. To settle this question it will be necessary to devise a method of measuring the conductivity of fibres. As in any case the conductivity will be very small, none of the ordinary methods will be applicable, and the deciding of this question will have an important bearing on the future course of the research. Thus the question of the effect of the nature and the quantity of the oil used for wool will depend largely on the solution of this problem. The research will have two main branches—the study of the means of getting rid of electrification, and the study of the process of "ageing" wool, with a view to shortening the time required.

Crystal Palace School of Engineering.—The Crystal Palace school has given up the premises at the foot of the South Tower, which it has occupied since it started some 40 years ago, and next term will be at a new home on Anerley Hill, close by. Mr. J. W. Wilson, the principal, recently stated that something like 2,000 students had passed through the school; more than 200 were on the roll of honour, and four had gained the Military Cross.

Appointments Vacant.—Electrical engineer and fitter (£85 +), for the Axbridge Union; telegraph foreman (£250), for the Government of the Gold Coast; junior shift engineer (£104), for the Birmingham Corporation electricity department; assistant (45s.), for the motor and meter department of the Heywood Corporation electricity department; temporary chief clerk (£140), for the Aberdare U.D.C. electricity and tramways department. See advertisement pages to-day.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing April 17th, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, April 17th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class.

Tuesday, April 18th.—6 to 7 p.m., School of Arms; 7.15 to 8.15 p.m., Recruit Drill.

Friday, *Saturday*, *Sunday*, *Monday*} Easter Training.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, April 13th, 1916:—

Battalion Parades.—Saturday.—Field Day. The Battalion will Parade outside Baker Street Station at 2.15 p.m., and proceed by train to Wembley Park, for Field Operations with the Corps of Citizens Battalion and other units. Operations will cease about 6.30 p.m.

Sunday.—The Battalion will Parade at Liverpool Street Station (low level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties. The Battalion will return to town about 6 p.m.

Easter Holidays.—The Battalion will proceed for Entrenching duties on Saturday and Easter Monday.

Musketry.—The Ranges at Bisley and Acton will not be open on Saturday and Sunday next, the 15th and 16th inst.

A. G. Joiner, *Major and Adjutant*, O.B.C.

For Sale.—The Port Talbot Railway and Docks Co. has for disposal two sets of 44-kw. Bellias engines and Crompton dynamos, and two sets of 36-kw. Scott & Mountain engines and dynamos. See advertisement pages to-day.

Electrometallurgy in Spain.—The engineer Domingo de Orneta, who is the discoverer of valuable deposits of chrome, nickel, and ferric ores in the Serrania de Ronda, gave an exposition recently before the Sociedad Malaguena de Ciencias of the measures he proposes to adopt for the electric smelting of the ores. Water power for the generation of electrical energy is available, and there are suitable sites for ironworks in the neighbourhood of the deposits. King Alfonso, in an interview granted in November last, conferred on Senor Orneta a concession for a complete scheme for the manufacture of ferro-chrome and ferro-nickel. Platinum obtained from these deposits is likewise the subject of present investigations.

An Electrician's Default.—At the Belfast Munitions Court, Wm. J. Burns, electrician, pleaded guilty to absence from work in a local engineering establishment without satisfactory reasons, and was fined 20s. The firm's representative stated that employment throughout the entire establishment was retarded by bad timekeeping in the electricity department.

Fatality.—Rotherham.—While A. Nicholls (40) was employed at the works of Messrs. Steel, Peech & Tozer, Ltd., cutting off lengths of steel with an electrically-driven saw, the saw broke, fracturing his skull and killing him. Verdict: Accidental death.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with th, technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—A long discussion *re* the resignation of the Oldham tramway manager (Mr. J. W. Dugdale) took place at the T.C. last week. The resignation was accepted at a private sitting, and the minute recording it added: "That Mr. Dugdale be paid his salary for a period of four months from date, and be relieved of all further duties in connection with the department."

The Walsall Electricity Committee has agreed to pay Mr. J. D. Spark, mains engineer, a bonus of £15 in respect of extra work performed by him up to the time the new station is working.

The Bury Corporation has increased the salary of Mr. J. G. Potts, electricity works superintendent, from £180 to £200 per annum, and the following other increases have been granted:—Mr. E. B. Fausey, chief shift engineer and assistant works superintendent, from £2 15s. to £3 per week; Messrs. J. Harridance, J. W. A. Renshaw, and V. Walker, shift engineers, from 50s. to 55s. per week; and Messrs. W. R. Bland, J. Stephen, and H. Strong, shift engineers, from 45s. to 50s. per week.

The Newport (Mon.) electrical engineer proposes to appoint Mr. W. H. S. Clarke, now distribution assistant, to the position of installations assistant, at £140 per annum. This fills the vacancy caused by the death of Mr. C. E. Covell.

The Rotherham Tramways Committee proposes increases in salaries to Mr. C. Webster, chief traffic clerk, and Mr. H. Jagger, traffic superintendent.

The Fulham Electricity Committee recommends that Mr. G. Hicks, assistant mains superintendent, be appointed assistant mains superintendent and supervisor of meters. His salary is to be increased to £160, with a maximum of £200.

General.—Mr. Claude W. Hill has removed his offices to 19, Old Queen Street, Westminster, S.W.

Mr. W. C. Mercer, of the electrical department of Messrs. Vickers, Ltd., Sheffield, and later electrician-in-charge at Messrs. J. & G. Wells, Ltd., Holbrook Colliery, has been appointed electrician-in-charge to the group of collieries owned by the Nunnery Colliery Co., Ltd., Sheffield, and he desires to receive lists, &c., of cables, mining switchgear, &c., at the Nunnery Pit, Sheffield.

Sir William Crookes, O.M., and Lady Crookes celebrated their diamond wedding on April 10th.

Dr. Edward Hopkinson is one of the members selected to go to India in connection with the inquiry of the Indian Commission on Industrial Development.

Anticipating the calling-up of his "Group," Mr. G. W. P. Page, A.C.G.I., A.M.I.E.E., who, for the past two years, has been chiefly engaged on publication and other technical work in the publication department of the General Electric Co., Ltd., has enlisted in the London Electrical Engineers.

Mr. H. B. Rowell has been elected president of the North-East Coast Institution of Engineers and Shipbuilders for the 1916-1917 session.

On April 4th, at Glasgow, Lieutenant G. S. Helme, A.M.I.E.E., R.F.A., of Messrs. Kelsall & Parsons, engineers, Glasgow, was married to Miss A. C. Morton, of Barrhead, Glasgow.

Roll of Honour.—Second-Lieutenant H. P. Bramwell, R.F.C., reported wounded with shrapnel while doing photographic work over the lines, is shortly being sent home. At the outbreak of the war he was with the B.T.H. Co.

Private Fred Worsman, who was formerly employed at the Bradford Corporation electricity works, has been killed whilst on active service.

Private James Wilkinson, of the Manchester Regiment, who has died of wounds, was formerly with the British Westinghouse Co., at Trafford Park.

Private Ernest Budding, aged 19, formerly employed by Messrs. Ferranti, Ltd., was killed during a Zeppelin raid.

Nelson Electricity and Tramways Committee has decided to place on record its appreciation of the gallantry of Corporal J. W. Smith, a tram conductor in the employ of the department, who has been awarded the D.C.M.

Obituary.—Mr. Barnet Weatherley.—The death has occurred, in his 78th year, of Mr. Barnet Weatherley, of High Street, Lewisham, S.E., for many years in business as an electrical engineer in the Borough.

NEW COMPANIES REGISTERED.

E. Powell, Ltd. (143,534).—This company was registered on April 7th, with a capital of £4,000 in £1 shares, to take over the business of an electrical engineer, motor and cycle agent and engineer, and gunsmith, carried on by E. Powell, the elder, at 41, High Street, Tunbridge Wells. The subscribers (with 200 shares each) are: E. Powell, sen., 41, High Street, Tunbridge Wells, engineer; P. Powell, 41, High Street, Tunbridge Wells, engineer. Private company. The number of directors is not to be less than two or more than five; the first are E. Powell, sen. (permanent), E. Powell, jun., and P. Powell. Qualification, £200. Solicitor: E. C. Frend, Tunbridge Wells. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

H. G. Cooper, Ltd. (143,526).—This company was registered on April 6th, with a capital of £2,000 in £1 shares, to take over the business of an electrical engineer and general office furnisher carried on by H. G. Cooper at 6, Fen Court, E.C. The subscribers (with one share each) are: H. G. Cooper, 6, Fen Court, E.C., electrical engineer and general office fitter; G. S. Edwards, 28, Plashet Road, Upton Manor, Essex. Private company. The number of directors is not to be less than two or more than five; the first are H. G. Cooper, G. S. Edwards, and Alice H. Cooper. Qualification five shares. Registered office: 6, Fen Court, E.C.

Selective Signal Co., Ltd. (4,330).—This company was registered in Dublin on April 4th, with a capital of £5,000 in £1 shares, to acquire any interests in patent rights, licences, &c. The subscribers (with one share each) are: W. J. Lyons, Royal College of Science, Dublin; G. M. Meares, Fernhill, Dundrum, Co. Dublin, solicitor; J. Lindsay, 17, Westland Row, Dublin, engineer; W. Conan, 44, Kildare Street, Dublin, merchant; F. P. Griffith, Temple Gardens, Rathmines, Dublin, engineer. Private company. The first directors are W. J. Lyons, W. Conan, F. P. Griffith, and G. M. Meares. Qualification, £50. Registered office: 17, Westland Row, Dublin.

Innovation Light Co., Ltd. (143,505).—This company was registered on April 3rd, with a capital of £2,000 in £1 shares, to carry on the business of makers and vendors of gas mantles, manufacturers of and dealers in lamps, brackets, globes, films, shades, glasses, burners, meters, galvanometers, ammeters, voltmeters, carbons, cut-outs, switches, motors, batteries, stoves, turbines, pipes, wires, and appliances used in connection with gas, electricity, &c. The subscribers (with one share each) are: J. O. Stacey, 2, Norfolk Street, Strand, W.C., solicitor; J. M. Avery, 2, Bridge Road, St. Margaret's, Twickenham, clerk. Private company. The number of directors is not to be less than two or more than five, the subscribers are to appoint the first. Registered office: 146, Bishopsgate, E.C.

Baxendale Bros., Ltd. (143,544).—This company was registered on April 8th, with a capital of £5,000 in £1 shares, to take over the business of a dealer in electrical supplies carried on by W. I. Baxendale at 29, Harrington Street, Liverpool, as Baxendale Bros., to carry on the same and the business of electricians, electrical and mechanical engineers, manufacturers of, dealers in, agents and contractors for electrical, mechanical, telegraphic, telephonic, photographic, optical, and other appliances, rubber, rubber hose, tires, motor cars, motor cycles, and accessories, &c. The company may not carry on any electrical business within 12 miles of the Manchester Town Hall, nor, prior to July 8th, 1923, carry on any business competing with the plumbers' material business of Baxendale & Co., Ltd., provided that this is not to restrict the company from dealing in plumbers' materials in a minor way as an adjunct only to its electrical business. The subscribers (with one share each) are: W. I. Baxendale, 5, Lingdale Road, West Kirby, Cheshire, dealer in electrical supplies; W. Walker, 81, Queen's Drive, Walton, Liverpool, manager (electrical supplies). Private company. The number of directors is not to be less than two or more than five; the first are W. I. Baxendale (permanent managing director, with £500 per annum) and W. Walker. Solicitor: J. T. Simpson, 42, Kennedy Street, Manchester. Registered office: 29, Harrington Street, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—Agreement to issue debenture stock, dated March 16th, 1916, to secure £6,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure £2,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure £2,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000. Property charged: The company's undertaking and property, present and future. Holders: W. M. Murphy, 39, Dame Street, Dublin; A. R. Monks, 123, Cannon Street, E.C.; H. Brown, The Red House, Parkside, Wimbledon Common; and J. B. Glenn, Moorgate Station Chambers, Moorfields, E.C.

Bright's Light & Power Co., Ltd. (58,290).—Capital, £200,000 in £1 shares (100,000 pref.). Return dated December 31st, 1915 (filed April 5th, 1916). All shares taken up; £1 per share called up on 66,667; £66,489 5s. paid, leaving £177 15s. in arrears; £33,333 considered as paid on the remainder. Mortgages and charges: £16,000.

City of Buenos Aires Tramways Co. (1904), Ltd. (82,214).—Capital, £1,240,000 in £5 shares. Return dated February 29th, 1916. All shares taken up and considered as fully paid. Mortgages and charges: £174,000.

United Flexible Metallic Tubing Co., Ltd.—A memorandum of satisfaction in full on March 29th, 1916, of debentures dated January 1st, 1907, securing £5,000, has been filed.

Woodbridge & District Electric Light Co., Ltd.—Issues on various dates from October 27th, 1913, to March 31st, 1916, of £1,000 debentures, parts of a series of which particulars have already been filed.

H. J. Cash & Co., Ltd. (79,701).—Capital, £10,000 in £1 shares. Return dated February 29th, 1916. All shares taken up; 17s. 6d. per share called up; £8,750 paid. Mortgages and charges: Nil.

Cambridge Electric Supply Co., Ltd. (36,457).—Capital, £100,000 in £10 shares. Return dated March 8th, 1916. 9,911 shares taken up; £9 per share called up; £89,199 paid. Mortgages and charges: £30,000 first debentures; also one debenture with bankers, to cover £15,000.

Atlas Carbon & Battery Co., Ltd. (34,857).—Capital, £2,000 in £1 shares. Return dated December 29th, 1915 (filed March 7th, 1916). All shares taken up; £8 paid; £1,992 considered as paid. Mortgages and charges: £3,000.

Electric Train Lighting Syndicate, Ltd. (112,932).—Capital, £5,200 in £1 shares. Return dated March 20th, 1916. All shares taken up; 5s. per share called up on 900; £225 paid; £4,300 considered as paid on 4,300 shares. Mortgages and charges: Nil.

Crossley Bros., Ltd. (51,970).—Capital, £973,700 in 40,339 pref. and 57,031 ord. shares of £10 each. Return dated March 9th, 1916. All shares taken up; £378,200 paid on 27,820 shares; £695,500 considered as paid on 12,519 pref. and 57,031 ord. shares. Mortgages and charges: Nil.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

Mr. J. Annan Bryce, M.P., presided on April 6th, at Hamilton House, over the annual meeting of this company. He said that sundry creditors stood at £409,000, as compared with £265,000, the increase being due to the larger scale of the business. There was an increase of £5,000 in the reserve for employer's liability, which the board considered advisable in view of the abnormal conditions existing at the works, arising out of the extra pressure at which they were operated, the large amount of female labour employed, and the inexperience of the fresh labour from which they had had to recruit their forces. The balance of £44,632 carried forward was an increase of £36,511 over last year, and it was necessary in view of the legislation of last session. As the nature of the excess profit tax was not even now generally understood, he referred to this at some length. It was imposed largely in deference to the demand of workmen that their labour should not be exploited by manufacturers making exceptional profits through war conditions. If the tax had been imposed solely on profits due to the war no exception could have been taken, but it speedily appeared that it would have been difficult, if not impossible, to distinguish profits arising *from* the war from profits made *during* the war. Naturally, the Treasury chose the course which not only was simpler, but brought a great deal more grist to its mill, and, accordingly, the tax was imposed on all businesses which had made more

profit during the war than before it. But it was unfair in all cases where a business was in a state of development, and where the larger profits in the year 1914 had no necessary connection with the war, and where, indeed, in many cases they would have been still larger but for the war. This was pre-eminently their own case. The war began on August 4th, 1914, and their accounts were closed on December 31st, 1914. They had, therefore, in their accounts only five months of the war, during the first of which business was almost paralysed, and during the last four of which it was exceedingly difficult to conduct owing to the loss of much of their skilled labour, partly by recruiting and partly from the sudden demands of the Government factories which, by enormous wages, tempted away many of their best men. Moreover, during the last four months of 1914, not only labour, but materials advanced in price, so that their costs were higher than estimated. Furthermore, in a business like theirs, the profits were not realised till long after the order was taken, and it might be said that none of their profits in the year 1914 were due to orders taken during the war months of that year, or even to orders taken in the pre-war months of that year. From all the above considerations they would see that not only were their larger profits of 1914, as compared with previous years, not due in any sense to the war, but were actually smaller than they would have been had there been no war. Yet they were called upon to pay to the Government half of the excess profits of 1914 over those of two out of the three pre-war years, 1911, 1912, and 1913, merely because, as the result of hard thought and hard work, their profits happened to be on an ascending scale, while other concerns which had reached their development sooner, were, though making far larger profits than themselves, entirely exempt from the tax. Surely, nothing more unfair could be imagined; yet the Chancellor turned a deaf ear to every argument, and in the Budget introduced two days ago he proposed to increase the injustice still further by raising the tax from 50 per cent. to 60 per cent. In August, 1915, they became a "controlled establishment" under the Munitions of War Act, 1915, and were consequently, as regarded the accounts for the year 1915, liable to a levy of 80 per cent. of their excess profits. How the taxing provisions of these two Acts would work out in practice had not yet been ascertained, as the basis of calculation was not quite the same, but the Chancellor of the Exchequer had announced in his Budget speech that he was determined to make the best of both worlds, and would levy the taxation under whichever Act gave the best return to the Treasury. The ordinary income-tax had within the last two days been raised from 3s. 6d. to 5s., and how much further it would go would depend on the duration of the war. Had the report been delayed until after the Budget, he was by no means sure that the directors would not have decided on a still greater provision. On the credit side of the balance sheet, stock and material on hand £1,098,000, showed a large increase on last year's figures of £759,000, but that and the increase of £128,000 in "sundry debtors" was accounted for mainly by the increased scale of the business, and partly by their having to work as a controlled establishment. Shares and debentures in other companies stood at about the same figure, but there had been an exchange of shares with their American friends who had parted with their holding in the French Co. in return for shares in the Traction & Power Securities and Clyde Valley Companies. In the profit and loss account, the net profit was £176,752, against £151,627, an increase of £35,125. It was not so large an increase as was shown in 1914 over 1913, but, under the circumstances, could be considered satisfactory. With regard to the business generally during 1915, their total orders received compared with those of 1914 showed an increase over the latter year of about 73 per cent., but this included one large single order for the electrification of an important railway amounting to about £500,000, to which there was no corresponding order in 1914, and certain war munitions work. After eliminating these two items, the general orders still showed an increase over 1914 of some 30 per cent. A considerable part of this increase was probably due to the absence of German competition, from which they had suffered so much in the past. They must hope that when peace was concluded this competition would be scotched for some time to come. Mr. Lloyd George was doubtless actuated by Christian principles when, in a speech the other day, he deprecated the introduction of revenge into the business, but, with human nature as it was, it would be surprising if the nations who had suffered from German barbarism were content to kiss and be friends, receiving Germany back into the comity of nations as if nothing had happened. And revenge apart, did not the policy of "kiss and be friends" simply mean that they would again lay themselves open to that unscrupulous penetration, as a step to domination, from which all the world had so long been suffering? The Commonwealth of Australia, under the bold leadership of Mr. Hughes, had already shown that she did not mean to run any such risk, and perhaps Mr. Asquith, during his journeyings, might have learned something of the intentions of their Southern Allies. Those who knew what was going on to-day in France were aware that she, at least, was determined in the future to allow no penetration, however peaceful. Both their domestic and Continental orders showed a good increase, but, as was only natural, having regard to prevailing conditions, their export sales showed some falling off. It was interesting to note that, notwithstanding the changed conditions at their works, they had had the minimum of friction with their workpeople, and, generally speaking, the most wholehearted assistance; and much credit was due to the tactful manner in which those in charge had dealt with the many difficult problems presented by present conditions. At the outbreak of the war they had on their hourly pay rolls 4,720 men and 513 women, = 5,233 total, while at the present time they had 5,504 men and 1,344 women, = 6,848 total. The Chairman next dealt with the war relief fund inaugurated by the staff to assist the dependents of men called to the Colours, and said the employés had raised £13,648, to which the board added £6,291. The number of men who had joined the Forces was approximately 2,000, and of these 70 had been killed in action, and many grievously wounded. In addition to this, some 3,500 men had attested under Lord Derby's scheme. Their school for the instruction of apprentices had grown considerably. Whereas on January 1st, 1914, they had 100 apprentices, of whom 30 attended school, on January 1st, 1916, they had 330 apprentices, of whom the whole number attended school, in addition to which 120 had joined the Colours; and they were particularly pleased to state that the class of boy now attracted to the works was greatly superior to that in former years. Twenty-three of their foremen were giving lectures, numbering in all nearly 100 in the course of the year, and the co-operation between school and shops was improving all the time. They had also inaugurated classes for girls engaged in the drawing offices, and were preparing a class for girl meter testers. The work of the school was attracting great interest on account of its novel nature. Four of the chief inspectors of the Board of Education had visited the school and discussed very fully the lines on which it was conducted, and Mr. Fleming had had several conferences with leading officials of the Board on the system pursued. Inquiries with regard to their methods had been received from many public bodies, companies, and private firms, and the fame of their system having spread, numerous applications for apprenticeships were coming from all parts of the country. Altogether, the school seemed to be doing a valuable pioneer work, and the greatest credit was due to Mr. Fleming, the superintendent of the transformer department, who had initiated and developed the scheme, and to those who had co-operated with him. Let them pay the devil his due. The efficiency of Germany, everyone must admit, was mainly due to the development of such methods of technical training, in which, unhappily, England had till now lagged behind. He did not believe in being too optimistic, neither did he desire to go to the other extreme, but they must all appreciate the trying times through which they were now passing, and, while their accounts showed that they had still further progressed over those of last year, there were indications that they might be still further taxed in order to help towards the heavy expenditure due to this devastating war, and further difficulties might be placed in the way of carrying on their normal business. Orders were still coming in well, and at the moment were slightly in excess of those at the corresponding period of last year, but it must be remembered that the large railway order in 1915, to which he had alluded above, was an exceptional one. Last year he discussed the destruction of capital likely to be caused by the war, and hazarded an estimate of 5,000 million pounds. That estimate to-day appeared absurdly moderate. Certainly they must look to a diminished purchasing power in the world, and a consequent depression in industry, but that depression would probably not show itself immediately after the war ended, and he still held to the view that even when it did come it might not affect, at least at first, industries such as theirs, which were necessary for the purposes of reconstruction and the economical working of other industries, especially as in their particular business the pressure of German competition was not likely to be so severe. It was partly due to their anticipation of post-war conditions that, with a view to broadening the basis of their business, they acquired the controlling interest in the French company. In France, as in England, German competition was before the war exceedingly keen, while after the war it was even less likely to be felt than here. The Italian company, in which they held through the French company a controlling interest, was also fully employed, mainly on munitions work, but here, also, the post-war prospects were good. The use of electrical apparatus, both for railway and other purposes, appeared likely to increase largely, while in Italy also a diminution of German competition appeared probable, though perhaps not to so great an extent as in France.

Mr. N. B. Dickson seconded the motion.

Mr. Tomkinson did not think Mr. Lloyd George intended they should kiss and be friends, and thought that it would be detrimental for such a statement to go out from that meeting.

Mr. Acland emphasised the injustice done to shareholders in the company, who had received no return for years, by the imposition of the excess profits tax. He suggested that they might protest to the Government, and say they would close their factory against Government orders.

Mr. Birks thought the shareholders would have something to say with regard to closing the factory. He saw no reason for the Chairman speaking in a minor key.

The Chairman said the interpretation put on Mr. Lloyd George's speech was not his, but that put on it by the Press. He had been a Free Trader all his life, and went into Parlia-

ment ten years ago to defend Free Trade. In a proper ideal state of affairs he was still a Free Trader, but could anyone go and shake hands with a man who had been robbing and violating and slaughtering all over the world? He did not feel he could do that, and, after all, nations were made up of individuals. He did not feel that this country, and still more France, Belgium, and Russia, would "kiss and be friends" with Germany after the war. If the Germans in the course of years became civilised, if they became entirely regenerated and changed their whole view of life, it might be possible to be friends with them. He had already urged the injustice of the excess profits tax in the case of a company like theirs, but he had not the slightest hope of convincing the Chancellor of the Exchequer.

The report was then adopted. A hearty vote of thanks to the staff was carried.

German Electrical Companies.

The Voigt & Haeffner A.G., of Frankfort-on-Main, proposes to distribute 12 per cent. for 1915, as contrasted with 8 per cent. in the preceding year.

The Dr. Paul Meyer A.G., of Berlin, which company makes switch apparatus, and closed the year 1914 with a deficit of £10,000, intends to pay a dividend of 7½ per cent. for 1915.

The report of the *Norddeutsche Kabelwerke A.G., of Neukolln*, which company was formed about a year and a half ago under the heading of the Mix & Genest Co. to acquire an undertaking having the same title, states that the results achieved in the year ended with September 30th, 1915, corresponded to expectations. The gross profits total £12,700, and the net profits £6,500, and a dividend at the rate of 8 per cent. has been declared.

The report of the *Deutsche Kabelwerke, of Berlin-Lichtenberg*, states that the company was satisfactorily occupied during 1915. Including the balance brought forward, the gross profits amounted to £73,000, as against £98,000 in 1914, but on this occasion the profits have been arrived at after making reserve provision for outstanding debts, investments, &c. After deducting general expenses, &c., and appropriating £1,500 for depreciation—all other accounts are already written off—the accounts exhibit net profits of £35,000, as compared with £32,000 in 1914. The dividend proposed is 6 per cent., as in the preceding year.

The Sachsenwerk Licht und Kraft A.G., of Niedersedlitz—the former Kummer works—reports that ordinary requirements in electrical manufactures existed in 1915, principally for various authorities and large industrial works. The change over for the production of war material which was begun in 1914 was continued last year, and the total turnover exceeded £1,500,000. As gross profits, the accounts show the sum of £209,000, as compared with £66,000, and net profits of £184,000 and £47,000 in the two years respectively. The directors propose a dividend of 18 per cent. on the ordinary capital of £225,000, as compared with 8 per cent. in 1914.

Swiss Electrical Companies.

The accounts of the *Aluminium Industrie A.G., of Neuhausen*, show net profits, including £14,000 brought forward, amounting to £379,000 for 1915, as compared with £280,000 in the preceding year. After allocating £140,000 to the fund for the gradual payment in full of the share capital, which at present is paid up to the extent of 60 per cent., it is proposed to distribute 20 per cent. on the paid share capital, being the same rate as in 1914.

The Société d'Exploitation des Cables Electriques, of Cortaillod, reports gross profits of £10,000 for 1915, as contrasted with £6,900 in 1914. The amount set aside for depreciation is £3,500, as against £2,900, and the net profits and balance forward are returned at £10,900, as compared with £9,500 in the preceding year. It is intended to pay a dividend of 30 per cent. on the share capital of £20,000, the rate in 1914 having been 25 per cent.

The Schweiz. Gesellschaft fur Elektrische Industrie, of Basle, which is an investment company associated with the Basle Handelsbank and the Siemens & Halske group, records gross profits of £173,000 for 1915, as against £193,000 in the previous year. After meeting interest on the loans totalling £2,400,000, and making various appropriations, the accounts indicate net profits of £49,000, as compared with £69,000, and the directors recommend a dividend of 5 per cent. on the share capital of £800,000, this contrasting with 7 per cent. in 1914. The undertakings in which the company is interested continued favourably to develop, with few exceptions, in the past year, but no new transactions were embarked upon.

Folkestone Electricity Supply Co., Ltd.

The annual meeting was held on March 31st. Ald. G. Spurgen said that, considering the abnormal circumstances under which the company had been working during the past year, the financial results were in every way satisfactory. The restricted lighting orders had necessarily affected to some extent the revenue receipts from private users and for public lighting. Substantial allowances had been made to the municipal authorities concerned. Capital expenditure during the year was £2,689. The all-round advances in the prices of materials and other costs were responsible for increased costs of production. Coal was the principal item, and their contract having expired they were obliged to enter into a fresh one at prices very considerably advanced. The gross profits amounted to £16,758, and although those figures were less than the corresponding amount of 1914, they were consoled by the fact that they had a larger amount to deal with as brought forward, and much less provision to make for the special items of depreciation. After payment of the usual debenture interest and preference dividend, they were able to maintain the same dividend on the ordinary shares (7 per cent.) as last year, to place £5,000 to the depreciation fund, £500 to the reserve, and to carry forward £2,602. During the year 2,333,415 units were generated, and 1,753,330 were sold. There were 116 new consumers, with an equivalent of 7,508 8-c.p. lamps. So far 22 men had joined the Imperial Forces, and half wages, amounting to £735, had been paid.

Clevedon, Portishead and District Electric Supply Co., Ltd.

The directors report a very satisfactory growth of the undertaking, the gross revenue for 1915 being almost exactly double that of 1914. The consumers connected to the mains in Portishead had increased from 130 to 179, and the new substation at Bower Ashton, now complete, had been supplying the South Liberty Colliery since Michaelmas. Further motors were now being put down at that colliery. The total revenue was £1,737, as against £887, and the gross profit was £696, against £444. The net profit was £487 (against £343), plus £72 brought forward. After paying 6 per cent. on the preference and 2½ per cent. on the ordinary shares, £150 was put to depreciation fund, £100 was put to writing down preliminary expenses, and £37 was carried forward. Units sold were 209,524, as against 56,096 in 1914. A further issue of 6 per cent. preference shares is being offered to holders, for extension purposes. The board thanks Messrs. Christy Bros., Ltd. for advancing (at 5 per cent. and without any security) the sums necessary to complete several very lucrative extensions. The Board of Trade is considering the company's application for leave to extend the mains through the village of Long Ashton.

Urban Electric Supply Co., Ltd.

For 1915 the gross profit was £68,513, as against £68,962, and after deducting expenses the balance was £65,312. Interest and debenture stock redemption absorb £43,423, leaving £21,889, which is applied thus:—5 per cent. dividend on preference shares, £12,500; to reserve for depreciation, £9,389. Annual meeting: Yesterday.

The following comparative table shows the equivalent in 33-watt lamps connected, also the profits:—

	Lamps.			Profits.		
	1913.	1914.	1915.	1913.	1914.	1915.
Hawick	76,964	82,665	91,909	£4,952	£5,503	£7,460
Stamford	40,261	44,985	49,948	2,004	2,351	2,643
Weybridge and Walton	78,725	86,545	93,122	5,881	6,281	5,473
Godalming	37,759	40,268	43,633	3,443	3,040	3,585
Twickenham and district ..	146,462	167,492	194,338	12,129	12,128	12,960
Dartmouth	26,539	27,398	27,948	2,171	1,821	1,836
Camborne and Redruth ("A") and Cornwall ("B")	179,038	199,877	215,202	"A" 7,882 "B" 11,775	"A" 7,477 "B" 17,325	"A" 7,499 "B" 14,273
Newton Abbot	24,950	28,647	32,852	2,252	2,549	2,451
Grantham	42,902	46,235	50,538	3,182	5,636	7,014
Glossop	35,422	36,390	38,341	2,651	3,018	3,727
Berwick	24,958	26,721	28,948	1,728	1,548	932
Caterham	19,916	21,079	23,421	2,074	1,925	1,688
Newbury	26,423	28,222	30,305	2,746	3,505	3,357
Totals	760,819	836,519	920,505	£64,871	£74,107	£73,890

Altrincham Electric Supply, Ltd.

During 1915, 76 new installations were connected to the mains, and the number of consumers is now 1,632. £4,059 new capital was expended. After providing for debenture interest, premium on debenture redemption policy, legal expenses, &c., the profit was £5,578, plus £1,567 brought forward, making £7,145. The dividend on the preference shares is paid, £500 is transferred to general reserve, and £1,500 to reserve for depreciation of plant, leaving £4,016 to be carried forward, out of which a dividend of 7s. 6d. per share is to be paid on the deferred shares, absorbing £2,625. The units sold were 1,676,081; units generated 2,059,855.

Brush Electrical Engineering Co., Ltd.

The report for the year 1915 states that the volume of output has been maintained, but high wages, the shortage of skilled labour, and heavy increases in the cost of fuel and materials have all tended to offset the improvement that would otherwise have been apparent in the net earnings. After providing for general charges, maintenance of plant and buildings, and interest on debenture stocks and loans, there remains £17,300, and £7,065 was brought in, making £24,365. The directors recommend that £8,000 be applied for depreciation of property, patents, and goodwill, £2,044 in payment of the further 4 per cent. interest to which holders of the 6 per cent. prior lien participating second debenture stock are entitled out of the first net profits available for dividend in any year, and £5,000 placed to reserve, carrying forward £9,321. £31,963 has been expended on capital account during the year, and the directors have not yet issued the balance of the 6 per cent. prior lien participating second debenture stock referred to in the last report, for the issue of which consent of the Treasury has been obtained.—*Financial News.*

Cork Electric Tramways and Lighting Co., Ltd.

The revenue for 1915 was £63,905, and the expenses were £42,415, leaving £21,490, plus £2,480 brought forward. Interest on debentures requires £4,600; 5 per cent. preference dividend £6,163; there is added to reserve for depreciation and renewals £6,500; £1,776 is to be written off wiring consumers' premises, repair shop equipment, plants on loan, &c.; £890 written off investments; and £4,041 is to be carried forward. Lighting and power business continues to show satisfactory progress, agreements for 147 connections being made, the additional connections amounting to 405 KW., as against 467 KW. in 1914. The revenue increased by £2,301, and the expenses by £4,457, due to high price of coal, war bonuses and allowances. The net revenue shows a material reduction in consequence, and no dividend on the ordinary shares is possible, as it is necessary to carry forward a larger sum than usual to provide against further increases in coal and other materials. Owing to the increase in expenses, the lighting and power tariff was raised from July 1st last, but the additional charges to the consumers represents a very small percentage of the increased cost of operating. £1,663 was spent on capital account, mainly for house services and cables, during the year. The 1,250-KW. Curtis turbine will be delivered shortly. Annual meeting: April 19th.

Passengers carried 5,899,003, as against 5,858,904 in 1914; car mileage 870,094, as against 832,227; lighting and power customers 2,973, as against 2,826; 8-C.P. lamps, 200,030, as against 186,477.

Woking Electric Supply Co., Ltd.—Mr. J. Ashby presided at the annual meeting, and, in referring to the large amount set aside to depreciation and renewals fund and to reserve account, he said that the company was not affected to any material extent by the war, but they could not say what might happen. The cost of coal had increased by £205 (6 per cent.), but they had sold 31,841 more units. It was largely due to the efforts of Mr. Bowden that they had reduced the coal consumption per unit. The increase in sales was largely due to the extra number of cookers sold during the year, there having been a great demand for cookers and heating apparatus.

Wycombe (Borough) Electric Light and Power Co., Ltd.—The connections increased during 1915 by 137 KW. to 2,392 KW. Including £184 brought forward, there is a net profit of £7,065, and after paying interest on debentures and outstanding accounts amounting to £3,263, £3,802 is available. A dividend of 2½ per cent. absorbs £1,000, £2,000 is to be placed to the reserve fund for renewal account, leaving £802 to be carried forward.

Lymington Electric Light & Power Co., Ltd.—Including £897 brought forward, there is a net profit of £2,447, and after paying debenture interest £450, and income-tax £112, £800 is placed to reserve, 5 per cent. dividend is paid on the preference shares, and £764 is to be carried forward. During the year £1,512 was invested in Colonial Government stock and War Loan.

Western Union Telegraph Co.—The *Times* New York correspondent states that this company reports for 1915 gross operating revenues of $51,171,795; operating expenses and taxes, $10,199,254; income from investments, $1,303,926. Interest charges amounted to $1,333,588, and the balance available for dividends is $13,531,921. The surplus, after providing for dividends, is $8,545,557. The total accumulated surplus is $18,882,969.

Yorkshire (Woollen District) Electric Tramways, Ltd.—A dividend of 4½ per cent. on the ordinary shares is to be paid for 1915, and £2,948 is to be carried forward. The revenue increased from £65,385 to £71,593.

Western Telegraph Co., Ltd.—Should the present net revenue be maintained, the directors will recommend at the general meeting a bonus of 2 per cent., which, together with the ordinary dividend of 6 per cent., will make a total of 8 per cent., free of income-tax, for the year.

Eastern Telegraph Co., Ltd.—A final dividend of £2 5s. per cent., and a bonus of 2 per cent., both free of tax, making a total of 8 per cent. for the year on the ordinary stock, are announced.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—A final dividend of 4s. 6d. per share is announced, together with a bonus of 4s. per share, both free of tax, making a total of 8 per cent. for the year.

Lancashire Dynamo & Motor Co., Ltd.—The *Financial Times* says that from various causes the balance sheet cannot be issued until some weeks later than usual, and the directors have, therefore, decided to pay a further interim dividend of 4½ per cent., free of tax.

Direct United States Cable Co., Ltd.—A final dividend of 2s. per share, less income-tax at 3s. 2d. in the £, making the total for the year 4 per cent., is announced.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—A dividend at the rate of 4 per cent. per annum for the past half-year has been declared.

Bombay Telephone Co., Ltd.—An Indian exchange states that this company proposes to increase its capital to Rs. 20,00,000 by the creation of 41,600 new shares of Rs. 25 each.

Sao Paulo Tramways, Light & Power Co.—A dividend of 2½ per cent. on the issued common stock is announced.

Rio de Janeiro Tramway, Light & Power Co.—A dividend of 1½ per cent. on the issued capital stock is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

The effects of the Budget are beginning to be felt in the Stock Exchange markets, and certain of the purely investment sections show some slight heaviness in tone. On the other hand, the imposition of heavier income-tax is making investors eager for such stocks and shares as those upon which the dividends are paid free of tax. In our lists there are various examples to be found in the telegraph market; while, in the Home Railway list, Underground Electric income bonds fall into the same category.

Generally speaking, business throughout the House is not at all bad, and the way in which the attractions of Exchequer Bonds are being re-advertised suggests that the Treasury may postpone, for some time to come yet, the issue of another War Loan. This consideration counteracts in no small degree the full effect of the 5s. income-tax; and investment has been resumed on behalf of the people in the Midlands and the North who are making money out of the various industries connected with the war.

Underground Electric incomes have risen 3 points to 86, and the shares are better at 1¾, while, sympathetically, the shilling shares improved to 6s. Another dramatic feature is a rise, also of 3 points, in Districts, this taking the price to 19¾. Dealers in the market are at a loss to account for the buying, but the surmise is that some American group has taken the stocks in hand—or, rather, has tried to do so. Perhaps a more natural explanation lies in the limited character of the market. A demand for £5,000 District stock—which, after all, would involve less than £1,000 money—is quite sufficient nowadays to move the price a couple of points or more. Metropolitans went up 1¼, and there has been rather more demand for South Western deferred, upon renewal of the statement that the company is doing well with its electrified system.

The Telegraph market shows the principal movements. As we have pointed out on several previous occasions, there is not much floating stock, beyond that which became available through deceased accounts; and the greater part of this was taken towards the end of last week. Good rises have occurred in Eastern Telegraph ordinary stock, Eastern Extension, and Western Telegraph shares. Globe ordinary gained 7s. 6d. That it is the matter of income-tax which is the principal attraction is obvious from the fact that the stocks of the Anglo-American and other companies which pay their dividends less tax have hardly participated—at any rate, up to the present—in the strength of the lists. The only exception is Great Northern Telegraphs, which are £1 higher.

Manufacturing shares are good. British Insulated are up 2s 6d., Telegraph Constructions £1, Henleys 5s., British Westinghouse preference 1s. 3d., and Electric Constructions 6d. Several of the others which exhibit no quotable change are difficult to buy at anything like the nominal prices. General Electric preference fell 5s. to 9½, and this is the only exception to the firmness of the market as a whole.

Electricity Supply prices keep somewhat irregular. The market is certainly getting into a healthier condition, and buyers are on the *qui vive* for cheap shares. The attention of these purchasers turns this week to the ordinary shares of the City, the County, and Westminster Companies. Chelseas have eased off, with Bromptons and Kensingtons. All the companies in this department pay their dividends less tax.

More favourable attention is being directed to Mexico. The stocks of the railway companies operating in the country are in some request, and there has been a little inquiry for the bonds of the utility concerns. Mexican Light & Power bonds are better, but Mexican Tramways are not quotably altered, though it is more difficult to get the offer of them than it was a week or a fortnight ago. The unexpected reappearance of Felix Diaz, the son of the old President, has reinforced the wavering hope that order will ever be restored in Mexico, although it is far from clear as to what recognition he will receive from the United States, committed, as they apparently were, to uphold the claims of Carranza.

Brazilian securities are also a little more popular, though Brazilian Tractions, after being 56, reacted to 54¼. The Argentine descriptions remain tolerably steady, but investors are a little cautious about the Argentine Republic at the present time, having regard to the unfavourable news with reference to the maize crop and the distinctly unpleasant nature of the traffic receipts on the various railways.

Canadian and American utilities are mostly good. The sensational rise in City Services common shares took the price up to within a point or so of 200, from which it fell back to 190 on sales by those who had got in early, when the rumours were first circulated as to the company's having discovered oil on its property. British Columbia Electric preferred and deferred stocks are both a point down, although the 4½ per cent. debenture hardened to 62.

Interest in Marconis stands arrested for the time being, awaiting a more definite statement from the Government as to what the company will receive for the use of its system. The United States has bought a few American Marconis, but the price has not improved to any noticeable extent; and Canadians loiter in the neighbourhood of 7s. 6d.

Armament shares are mostly better, thanks to the declaration by Armstrongs of a good dividend. The rubber market, too, is good, although business has fallen off fairly substan-

tially from what it was a fortnight ago. The shrinkage of business, however, has not brought about profit-taking to the extent that it usually does in such cases.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price April 11, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅜	— ¼	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	5	4	8½	— ½	6 3 1
City of London	9	8	11⅛	+ ¼	6 14 9
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	+ ⅛	6 16 7
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	5	— ½	7 0 0
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	3½	3	2⅝	—	6 4
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	—	6 16 2
South London	5	5	2½	—	8 13 10
South Metropolitan Pref.	7	7	1 15/16	—	6 14 0
Westminster Ordinary	9	7	5½	+ ½	6 1 9
Telegraphs and Telephones.					
	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		98⅛	—	6 1 10
do. Def.	33/6		21½	—	7 19 3
Chile Telephone	8		6⅝	—	6 5 6
Cuba Sub. Ord.	5		7⅞	—	6 9 0
Eastern Extension	7		183½	+ ½	*5 5 8
Eastern Tel. Ord.	7		131	+ ½	*5 6 10
Globe Tel. and T. Ord.	6		10⅜	+ ⅜	*5 11 8
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		35½	+1	6 4 0
Indo-European	13		50	—	6 10 0
Marconi	5		2 7/16	— ⅛	4 11 4
New York Tel. 4½	4½		100⅜	—	4 9 4
Oriental Telephone Ord.	10		1¼	+ ⅛	5 6 8
United R. Plate Tel.	8		6	+ ⅜	*6 13 4
West India and Pan.	1		1 1/16	—	9 10 6
Western Telegraph	7		13½	+ ⅜	*5 5 8
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 18 6
Metropolitan	1½		24⅜	+1½	4 2 0
do. District	Nil		10⅜	+⅜	Nil
Underground Electric Ordinary	Nil		1⅜	+ 1/16	Nil
do. do. "A"	Nil		6/-	+6d.	Nil
do. do. Income	6		86½	+3½	*6 18 9
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		3⅝	—	7 6 8
do. 2nd Pref.	5½		9⅜	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		54½	—	6 8 6
Bombay Electric Pref.	6		10½	—	5 17 3
British Columbia Elec. Ry. Pfce.	5		53	—	9 8 8
do. do. Preferred	—		37	—1	Nil
do. do. Deferred	—		33	—1	Nil
do. do. Deb.	4½		62 xd	+ ⅛	6 17 1
Mexico Trams 5 per cent. Bonds	—		41	+	Nil
do. 6 per cent. Bonds	—		85	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		32	—	Nil
do. 1st Bonds	—		41	+ 3	—
Manufacturing Companies.					
Babcock & Wilcox	14		23	—	5 1 8
British Aluminium Ord.	5		23/6	—	4 5 0
British Insulated Ord.	15		10½	+ ½	7 2 10
British Westinghouse Pref.	7½		2 7/16	+ 1/16	7 5 8
Callenders	15		11½	—	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		8⅜	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		57 xd	—	8 15 8
Electric Construction	6		15/6	+6d.	7 14 1
Gen. Elec. Pref.	6		9⅛	— ¼	6 6
Henley	20		15	+ ¼	*6 13
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		9⅛	—	*10 10 6
Telegraph Con.	20		35½	+1	*6 13 4

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £	Receipts for the month. £	No. of weeks.	Total to date. £	Total to date. £	Route miles open.	Inc.
Blackpool-Fleetw'd	April 1	1,168	— 162	13	4,060	— 88	8	..
Bristol (Trams)	Mar. 31	16,915	+ 181	13	57,861	+ 2,713	30·5	..
Cork	30	1,722	— 85	13	5,829	+ 76	54·25	..
Dublin	31	22,831	+ 246	13	75,344	+ 4,297	9·89	..
Hastings	31	2,780	— 251	..	..	— 33	19·8	..
Lancashire United	29	6,128	+ 85	13	20,247	+ 1,024	42	..
Llandudno-Col. Bay	31	750	— 124	13	3,953	— 54	6·5	..
Tyneside	Mar. 15	1,885	— 193	11	5,272	— 179	11	..
Anglo-Argentine	Mar. 15	214,081	+5,598	12	609,322	— 1,854	..	..
Auckland	10	20,711	+ 804	36½	189,937	+ 3,002	25·42	1·06
Calcutta	28	18,088	+1,497	..	..	+ 836	..	..
Kalgoorlie, W.A.	Jan.	2,286	..	..	..	..	..	..
Madras	Mar. 31	4,353	+ 311	13	12,554	+ 1,280	..	..
Montevideo	March	31,956	+2,240	21	158,422	+10,553	..	..
Dublin-Lucan Rly.	Mar. 31	439	— 98	13	1,466	— 89	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 12th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£28	..
a Copper Sulphate	,,	£49	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	95/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	120/-	60/- inc.
a Sodium Bichromate, casks	per lb.	10d.	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4⅝	..
c ,, Tubes (solid drawn)	,,	1/5 to 1/5½	..
c ,, Wire, basis	,,	1/4⅜ to 1/4⅝	..
c Copper Tubes (solid drawn)	,,	1/6½ to 1/6⅝	..
g ,, Bars (best selected)	per ton	£148	..
g ,, Sheet	,,	£149	..
g ,, Rod	,,	£148	..
d ,, (Electrolytic) Bars	,,	£135	£2 dec.
d ,, ,, Sheets	,,	£153	£2 dec.
d ,, ,, Rods	,,	£149	£2 dec.
d ,, ,, H.C. Wire	per lb.	1/4⅜	⅛d. dec.
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/2	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/0½	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	95/-	6/3 inc.
l ,, Wire, galv. No. 8, P.O. qual.	,,	£32	..
g Lead, English Pig	,,	£35 5	15/- dec.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£204	..
n ,, Wire, Nos. 1 to 16	per lb.	2/11	2d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Holsworthy Gas & Electric Supply Co., Ltd.—Mr. J. Mc. T. Dickson, presiding at the annual meeting, said that the stand-by plant for the electricity undertaking, which had been contemplated ever since the inauguration of the company, was about to be installed at a cost of between £400 and £500, which would be raised by 5 per cent. second debenture stock shares. The receipts from sale of electricity amounted to £296 during 1915, and from gas £1,086.

Isle of Wight Electric Light & Power Co., Ltd.—The accounts for 1915 show a profit, including £2,374 brought in, of £12,867. After providing for interest and sinking fund on debentures and the 5 per cent. preference dividend, the directors transferred £3,500 to the renewal fund and carried £1,367 forward.—*Financial News.*

International Lighting Association.—For 1915 the net profit was £1,505. After paying the preference dividend, 5½ per cent. for the year, £451 is to be carried forward.

Cambridge Electric Supply Co., Ltd.—The profit for 1915, including £2,647 brought forward, was £12,006. After placing £2,000 to depreciation account, and paying 5 per cent. dividend, £2,753 is to be carried forward.

Winnipeg Electric Railway Co.—The *Financial Times* states that the net earnings for 1915 were $1,331,737, as compared with $1,685,093 for the previous year. After providing for fixed charges and dividends amounting to 9½ per cent., the net result was a deficiency of $388,898, reducing the credit balance brought forward to $782,598.

Oriental Telephone & Electric Co., Ltd.—A dividend on the preference shares at the rate of 6 per cent. per annum for the last half of 1915, less income-tax, is announced, also a final dividend of 6 per cent. on the ordinary shares, free of income-tax, making a total of 10 per cent. for the year.

City of Oxford Electric Co., Ltd.—After paying a dividend of 4½ per cent., £355 is transferred to reserve and £1,563 is carried forward.

Monte Video Telephone Co., Ltd.—An interim dividend at the rate of 6 per cent. per annum for the half-year, less tax, is announced.

Leamington and Warwick Electrical Co., Ltd.—After paying 5 per cent. dividend, £1,883 is to be carried forward.

SWITCHBOARDS IN THE MAKING.

ALTHOUGH the standardisation of electrical apparatus and plant has made considerable progress in late years, yet in certain directions considerable variation in arrangement or design is still practically a necessary feature.

THE NEW DRAWING OFFICE.

The average switchboard is a typical example, in which the numerous combinations of measuring instruments, protective devices and controlling apparatus for plant of varying type and size almost always entails a special design to suit the particular conditions.

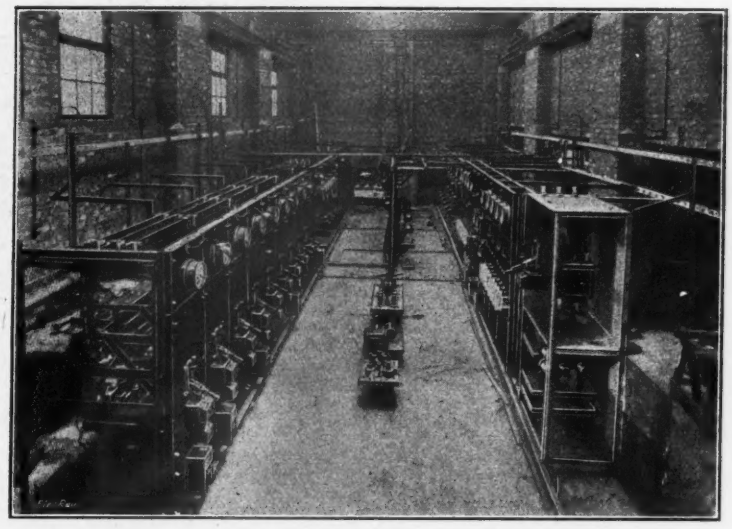
In fact, such are the peculiarities of this class of work, that large firms may find it desirable to leave the unstandardised portion to smaller organisations, while they concentrate their attention on the standard switches, instruments, &c., used in the construction of such boards. Another factor bearing on this arrangement is the frequency with which engineers specify particular makes of apparatus to be mounted on the boards, with the result that one firm's standard products cannot always be adopted.

The conditions referred to above led Messrs. Ferguson, Pailin & Co., Ltd., about 2½ years ago, to commence a specialist business in switchboard building at Higher Openshaw, Manchester, the principals having already had extensive experience in this class of work with well-known firms. The firm confines itself to the assembly and connecting up of proven apparatus made by reputable firms, and such has been the demand for its switchboards, that the firm has recently been compelled to extend its premises to cope with it. Our views show a new erecting shop and extended drawing office at the works; the former shop allows for three rows of switchboards being in progress at the same time, and, the building being lofty, enables one board, when complete, to be lifted over the others for removal for packing, &c. Each board is erected on channel bases fixed in the floor, while wall stays are provided attached to adjustable brackets. Every switchboard is assembled complete to ensure accuracy of finish, and for packing as little as possible of the gear is dismantled.

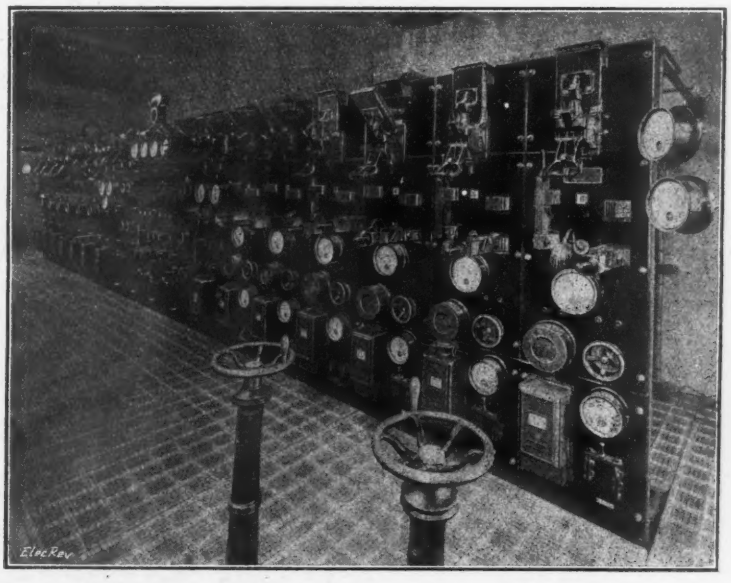
A special machine has been developed for bending the heavy copper interconnections required between pieces of apparatus.

The design of switchboards is a very considerable factor in the manufacture; each board is set out in detail, the general disposition of interconnections being determined, and complete records are kept in view of possible extensions being required.

The range of manufactures dealt with comprises all classes of flat-back boards for alternating and direct-current work, mechanically and electrically remote controlled boards for heavy plants, high tension cubicles, interlocked, and non-interlocked for sub stations, neutral point earthing resistances, &c.; heavy-power switchboards have been manufactured for plant of 30,000 volts and 15,000 amperes, and it is of some interest to record that the average yearly output of switchboards will control some 81,000 H.P. of plant, the apparatus having been supplied to 23 municipal electrical departments and many industrial firms, both at home and abroad.



EXTENSION TO THE SWITCHBOARD ERECTING SHOP, MESSRS. FERGUSON, PAILIN'S WORKS.



SWITCHBOARD SUPPLIED BY MESSRS. FERGUSON, PAILIN & CO. FOR A GLASGOW SUB-STATION.

Chemistry at University College.—A series of new chemical laboratories and research rooms has been erected at University College, Gower Street, which is said to be the finest in the kingdom, and unsurpassed upon the Continent. A sum of £20,000 is required to complete the equipment, of which £14,000 is urgently needed, and the treasurer, Capt. the Hon. Rupert Guinness, M.P., will be glad to receive contributions for this purpose at the College. In view of the immense importance of chemical research to this country, we cordially commend this appeal to our readers.

THE HIRE AND MAINTENANCE OF CONTINUOUS-CURRENT MOTORS.

On April 3rd the Western Local Section of the Institution of Electrical Engineers discussed Mr. H. Joseph's paper on this subject, of which an abstract appeared in our last issue.

Mr. H. Faraday Proctor said he noticed that the cost of maintenance had increased from .2 per cent. in 1903 to 6.2 per cent. in 1915, and that the author expressed his opinion that it had now just about found its level. He thought the cost of maintenance of large motors would prove to be less than the maintenance of small machines, and would depend on the class of parts supplied, and the number of breakdowns, rather than on the cost of repairing the breakdown. The author said he never disputed liability in the event of a breakdown; this was a point they considered very carefully when they were contemplating the hiring of motors in Bristol. They were afraid that if they undertook the maintenance of the motors it might lead to carelessness on the part of customers' employés. In Bristol, they only let motors out on simple hire, but a customer might take over the motor at an agreed depreciation at any time he pleased. He had often noticed that a man would hire a motor in the first instance, and directly he had proved that the equipment was to his satisfaction he would buy it.

Mr. E. G. Okell asked whether the author placed any limit on the size of the motor, and the character of the maintenance that was most expensive.

Mr. P. F. Crinks thought that a totally-enclosed motor would make a more satisfactory—and probably a cheaper—arrangement for a damp situation than placing the motor outside the building.

Mr. A. C. McWhirter, referring to the equipment of the workshop, considered that a stove with which to dry out the machines was a very essential item. Regarding soldered connections, he entirely disagreed with the author, as his firm did a great deal of soldering, and never got any trouble, unless it was due to careless workmanship. He thought many people under-cut the mica to too great an extent. Regarding the rewinding of armatures, his experience was that a tremendous amount of labour was wasted in using old material, which probably broke down immediately the motor was put to work. In certain cases, he considered ball-bearings very desirable, especially at the commutator end, although he agreed that a roller bearing constituted the best arrangement in most instances. He thought periodical and systematic inspection the best arrangement for maintenance jobs.

Dr. D. Robertson agreed with the author regarding the want of a really good starter. Recently he ordered a starter from a firm of good repute, and, although the resistance coils were very nicely built up, the frame on which they were mounted was much too light, and after a little time a number of short-circuits were caused owing to vibration. His experience was that, not infrequently, the starting gear was just as expensive as the motor itself.

Mr. Joseph, in replying, said that the arrangement he had adopted was to keep the cost of materials for motor repairs in a "motor repairs account," and not in a separate account of the repairs to each different size of motor. The smaller motors did cost more, in proportion, to repair than the larger ones. With regard to the question of liability in the event of a breakdown, they knew there was a certain amount of risk that a man might badly treat the motor, but they were prepared to take this risk in the same way as an insurance company had to take risks. He found that the motors were as well cared for since they had done the maintenance as in the days when they only did the simple hire. They endeavoured to get the owner to appoint one man to look after the motors in a particular department, and to make that man responsible for them. The man knew that if the motor broke down, the mill, or the section of the mill, would be stopped, and his desire to prevent such a thing happening was usually sufficient inducement to make him endeavour to prevent a breakdown occurring owing to neglect or carelessness. The maintenance factor that was most expensive was the labour involved. One man spent nearly all his time on repair work, and, when necessary, others were called off other jobs to give assistance, and the cost of their time was properly allocated to the work they actually did. He thought labour represented 75 per cent. of the cost of maintenance, especially now that they were doing their own rewinding. Referring to damp situations, he said that in a Scotch milling house the atmosphere contained a large amount of moisture and of nitrous oxide, which would be destructive of anything that could be used to make a motor. In these circumstances, and as they did not wish to supply special motors for special jobs, they preferred to install an ordinary motor outside the house rather than to supply a totally enclosed motor and run the risk of its getting corroded. They did not use a stove, but heat was obtained from steam supplied by the boiler house. He agreed as to the danger of under-cutting the mica to too great an extent. If a motor had been running very well, they would not cut the mica at all, but he had frequently found in the case of a motor described by the customer as a bad motor, that there was nothing really amiss beyond the mica being a bit high, and when this had been skimmed up the motor ran excellently. His remarks about ball bearings had been somewhat misunderstood. He did not mean to suggest that there was anything wrong with ball bearings; his objection to them was purely a local one, due to the time required for effecting a repair. For instance, it would probably take about three hours to take the armature of a 30-h.p. motor out, as they would have to take the end shields off, which would be a lengthy matter. He had some motors in use with ball bearings, and the proportion of troubles had been quite as great as with the other type. About four years ago he set to work to have all the motors inspected, as he thought this was the proper thing to do. His experience, however, proved most unfortunate, as he often found that probably a fortnight after the man had called a motor broke down, although the machine appeared to have been running satisfactorily when inspected. They were now getting the customers to let them know when they thought anything was amiss, as it was more likely that the customers would notice anything going wrong than a man who called and only saw the machine running for a short time. In Leeds, where there were about five times as many motors installed, he believed they had men going round who did nothing else but inspect motors. If they had this system in Hawick, the cost would probably be about double what it was; in other words, it would cost as much, or more, to inspect the motors as to repair them. With regard to the framework of starters frequently being too light, he had experienced this trouble himself, and he believed it was now quite a standard practice in most towns, where this business was carried on, to have iron fixing boards drilled with standard holes. This was an ideal arrangement, but he did not think it could be adopted in small towns like Hawick until there was some form of recognised standard starter; at present there were all sorts and sizes of starters.

HIGH-TEMPERATURE WORK.

The March meeting of the Faraday Society was devoted to what was called an informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory." Sir Robert Hadfield, F.R.S., President, was in the chair, and the discussion was opened by Dr. J. A. Harker, F.R.S., whose important work at the National Physical Laboratory entitles him to speak on this subject with exceptional authority. A large audience, which included some of the best-known workers in this field, kept up an eminently practical discussion till long after the normal time for concluding meetings.

The President's short introductory address told of the difficulties he and other experimenters had to contend with in times gone by in trying to melt small quantities of metals like steel or copper in the laboratory. That was before the advent of the electric furnace, which had wrought so great a revolution in high-temperature work; but progress in pyrometry was a factor of no less importance, and he gave in this connection a short historical sketch, beginning with Wedgwood's work in 1782, and coming down through Le Chatelier, Osmond, William Siemens, Roberts-Austen and Callendar to the recent work carried out by some who were going to take part in the discussion that night.

Dr. Harker dealt almost exclusively with carbon resistance furnaces, first made by Liveing and Dewar. A simple method of making a furnace was to bore out an arc carbon, but the hardness of the carbon made this difficult. Fortunately, the General Electric Co. now had a stock of thin-walled carbon tubes in many sizes for this purpose. The advantage of carbon was its high specific resistance. Graphite was much easier to handle and bore—it turned as easily as a hard wood—but its low resistance, one-fifth that of carbon, was a drawback, and it necessitated turning the tube into a spiral. One had only to wrap copper conductors round the ends of the tube and the furnace was essentially complete.

Dr. Rosenhain, later on, suggested coating the carbon tube with copper, aluminium, or iron, by the Schoop spray process, burnishing the coating to give good metallic contact. It was attention to small details, such as the resistance of the end contacts, which made all the difference between a good and a bad furnace. Great local heating at the contacts was fatal to success, and water cooling was now usually adopted. The furnace had, of course, to be enclosed, both for heat-insulation and to prevent the escape of carbon monoxide fumes. The most recent type of furnace, built by Mr. Eden at the National Physical Laboratory (shown in operation at the meeting), used ferro-concrete for this purpose, in preference to firebricks.

Dr. Greenwood, however, stated his preference for firebrick for many purposes, on account of the ease with which a brick furnace of any size or shape could be put together, and for lagging he preferred charcoal. Dr. Harker, on the other hand, recommended that fine grade of soot known as painter's lampblack. Filling up with this material the space all round the carbon tube for a radial distance of three inches gave most effective insulation at high temperatures. The one kilowatt which maintained the furnace exhibited at 2,000 deg. C. only heated the outside wall of the furnace to something over 100 deg. This temperature of 2,000 deg., by the way, was attainable in two or three minutes. To prevent the soot from falling through the spiral groove in the carbon or graphite tube, it was only necessary to wrap filter paper

round the tube. Its ash sufficed to keep the light soot from falling.

An important point in connection with these furnaces was their economical running. It was necessary to obtain high temperatures with little power consumption. For this purpose Dr. Harker used a small, home-made portable transformer, on which were 80 turns of primary, split so as to be used at 300 volts and downwards, and 3 secondary turns capable of being coupled in series or parallel. Currents up to 1,000 amperes could be obtained. One of the furnaces exhibited was to be sent to Hadfield's Steel Works, at Sheffield, for standardising optical pyrometers, which appear to be largely in use, for these particular furnaces were used for a like purpose at the National Physical Laboratory.

Mr. R. S. Whipple said that furnaces like Dr. Harker's, but larger, had been installed by Northrup, in America, for gear-hardening. Thermo-couples passed through the furnace on to the work, which was simply brought above the recalescent point as indicated on a recording pyrometer, and then taken out and quenched—a beautiful industrial application of scientific phenomena.

Useful as is the carbon tube furnace, the presence of carbon and carbon compounds is often a drawback where perfectly pure metals or alloys have to be melted, and the discussion turned largely on substitutes for carbon. On a small scale, Dr. Rosenhain and others have found a tungsten wire vacuum furnace effective, and pure iron (M.P. 1,525 deg. C.) can be melted in such a furnace. But the tungsten becomes brittle on cooling from a high temperature, and a fresh winding is necessary for every run. Up to 1,000 deg. C. Mr. C. R. Darling and Mr. H. G. Lacell were able to recommend a kieselguhr tube wound with nickel-chrome wire. A furnace 1 ft. long, using an inch tube, consumes only ¼ kw., and it can be rigged up in a few minutes. The arrangement should prove useful in innumerable directions. For very high temperature work, such as melting platinum or iridium (over 3,000 deg. C.), gas or oxy-hydrogen had still to be used, but experiments in the use of pure zirconia tubes for resistance furnaces are being carried out at the National Physical Laboratory, and if these should prove satisfactory this aspect of the high-temperature problem will be solved.

Mr. H. A. Kent drew attention to the possibilities of surface combustion; if one could use pure zirconia in granular form almost any temperature could be so attained. Nevertheless, the possibilities of gas furnaces have not by any means as yet been exhausted, although the present uncertain quality of coal gas is at the moment a difficulty. Much was said in the course of the discussion about the modern high-pressure types, in which not only the pressure, but the violence and turbulence of the explosive mixture as it enters the jet, is a necessary condition—as it is in a gas engine cylinder—of high-temperature combustion. One type described by Dr. Rosenhain in use at the National Physical Laboratory has a special form of injector burner for use with compressed air at 100 lb. per sq. in., and with this temperatures up to 1,800 deg. C. are obtained. An excellent burner is that bearing the name of Mr. Brayshaw, and it was described by the inventor. The essence of this burner is the wings, or side-pockets, round which the mixture of gas and air under pressure circulates becoming violently agitated on the way to the jet.

Mr. A. J. Webb said he had accidentally melted a large piece of platinum in this burner with an air pressure of only 20 lb., while small quantities could be melted with 3 lb. air pressure.

Sir Robert Hadfield said that Bessemer had worked with very high pressure blasts at one time, and he was glad the idea was being taken up again; he believed they would have a great future.

DIESEL ENGINE USERS' ASSOCIATION.

At the March meeting of the Association the subject of "Tar Oils as Fuel" was further discussed, and the President, Mr. Geoffrey Porter, gave some particulars concerning the unfavourable results which had been obtained in mixing tar or tar oils with ordinary crude oil for use in Diesel engines.

Mr. W. Fennell introduced the subject of the use of paraffin oil as fuel. In the discussion which ensued, the opinion was expressed that paraffin could be quite suitably used as fuel at times when its price showed any advantage as compared with the price of other fuels. It was necessary to run at a lower blast pressure when using paraffin.

The Honorary Secretary read a report which had been made to Lloyds' Underwriters by Mr. P. H. Smith on the accident which occurred in the Smithfield Markets Electric Supply Co.'s power station on February 6th.

According to the report, the compressor attached to the engine is of Messrs. Reavell & Co.'s standard quadruplex type, comprising four cylinders, viz., two low-pressure cylinders, one intermediate, and one high-pressure. The air is drawn into the low-pressure cylinders through slots in the piston pin, and is then compressed, passing into the L.P. receiver or purge pot, through copper pipes immersed in the water jacket of the compressor. This purge pot contains a drain and regulating valve, and a relief valve set at about 100 lb. per sq. in. The air from the L.P. purge pot is drawn into the I.P. cylinder past a valve through another cooling coil. Then it is compressed and delivered past another valve into the I.P. purge pot, which is almost identical with the L.P. pot, except that its relief valve is set to blow freely at 300 to 400 lb. pressure. From the I.P. pot it passes into the H.P. stage, from which it is delivered to the small bottle, being cooled immediately after passing the H.P. delivery valve.

The compressor is so designed that, under normal conditions, and when pumping its full capacity, the absolute terminal pressures of the various stages are approximately:—L.P., 60 lb.; I.P., 240 lb.; H.P., blast pressure.

A feature of the design to which particular attention is called is the construction and location of the I.P. plunger. This being, so to speak, inverted, receives an excess of lubricating oil, which when the engine is standing collects in the inverted piston and can, in actual practice, get past the rings into the cylinder itself. The rings are forced tight against the cylinder walls not merely by their own spring, but by air pressure passing behind the rings, the air being conducted thereto by four small holes communicating from the inside of the cylinder to the ring grooves.

It appears that this construction greatly facilitates the ingress of the oil to the I.P. cylinder when the engine is allowed to stand, and as seeming to corroborate that the oil actually takes this path, it is worthy of note that in most cases these holes soon choke up. In the case of the compressor under examination, two out of the four holes were choked. Further evidence of the ingress of the oil in this manner is supplied by the extraordinary condition of the H.P. valves, which were both very heavily carbonised in 30 hours' running.

Assuming that both H.P. valves are inoperative, the L.P. terminal pressure may reach a maximum of 60 lb. absolute and the I.P. terminal pressure is that of the blast. But the L.P. terminal pressure is approximately the I.P. suction pressure. If the compressor is running slowly with the L.P. drain valve fully open, the pressure in the L.P. purge pot will not greatly exceed atmospheric pressure. Hence, on the assumption that the H.P. valves are both inoperative, the pressure in the I.P. cylinder would be raised from slightly above atmospheric pressure to the blast pressure in a single stage.

These conditions apparently prevailed to an indefinite degree at the time of the accident, for, at the inquest, driver Baker remarked that he had started the engine in the usual way, the drain valves on the compressor being open. Then, when the engine commenced to fire, he closed them and immediately turned to the blast bottle. He had just commenced to throttle the blast to recharge the bottles when the explosion occurred. His estimate of the number of revolutions of the engine to the time of the explosion is only 20.

What happened was that the I.P. purge pot burst. The pot was of good average quality iron, and was of even thickness. Assuming its tensile strength at 7 tons per sq. in., its bursting pressure would be about 2,400 lb. per sq. in. Hence, no pressures ordinarily prevailing in the compressor would be likely to cause its fracture.

Mr. Smith therefore submits that the pressure originated from a spontaneous ignition of oil vapour in the I.P. purge pot, the temperature necessary to produce the ignition arising from the compression of the air in the I.P. stage. Provided that the oil is very finely divided, it may combine with oxygen with sufficient rapidity to cause it to ignite, notwithstanding that the surrounding temperature is well below the ignition point of oil vapour.

Assuming that the flash point of the oil were as high as 450 deg. F., the inlet temperature to the I.P. only 80 deg. F., and that the compression follows the law $PV^{1\cdot25} = K$, then the I.P. stage has to compress the air to 1/14th of its original volume to attain 450 deg. F. as the terminal temperature. Working at full capacity, this is the equivalent of raising the pressure in the I.P. stage from, roughly, 60 lb. absolute to 800 lb. This of itself is quite feasible provided that the I.P. relief valve was inoperative.

The evidence is that the I.P. relief valve did not blow, so that it is very probable that the terminal I.P. pressure was well below 800 lb., as, on testing the I.P. valve, it commenced to lift at 350 lb. Probably the valve would not have lifted under 400 lb. pressure at the time of the accident, but assuming now that the terminal I.P. pressure was 330 lb. when the explosion occurred, or well below the pressure at which the valve was nominally set, the initial pressure would have been 10 lb. gauge pressure to result in the attainment of 450 deg. F. terminal temperature under the assumptions specified above.

From a study of different drivers, Mr. Smith is strongly of opinion that in the time elapsing between Baker's closing the L.P. drain valve and turning to the bottles, the L.P. pressure had not attained even this figure. Hence, on this hypothesis, he finds a very possible explanation of spontaneous ignition arising.

The fractured purge pot showed a black deposit on an otherwise clean fracture in the pipes communicating with the pot, and also inside the pot. The inside of the Chelsea purge pot recently examined did not dirty the fingers at all. Hence, he concludes that an ignition explosion occurred, and makes the following recommendations accordingly:—

1. Fit pressure gauges on both L.P. and I.P. purge pots.
2. The holes leading behind the I.P. rings to be plugged. This will probably prevent the oil gaining easy ingress to the I.P. cylinder and so reduce the heavy carbonisation of the H.P. valves.
3. Fit a large relief valve to the I.P. and L.P. pots.

4. Relief valves should be tested periodically for lifting pressure.

5. There may be some advantage in fitting a non-return valve between the H.P. delivery and the bottle. This valve should be fitted as close to the H.P. outlet as is convenient.

6. Drivers in charge should make a habit of feeling the temperature of the purge pots. The L.P. is always the hotter when the machine is in good order, but when the H.P. valves become defective the I.P. becomes warmer.

7. To safeguard the water jacket, it is advised to work with an open top to the compressor, or where this is difficult to fit, then in place of the diaphragm or relief valve usually fitted, it is advised to place a stand pipe 4 in. to 6 in. diameter of sufficient height to obviate "head" difficulties.

The next meeting of the Association was to be held on Wednesday, April 12th. Information concerning the Association can be obtained from the Hon. Secretary, Mr. Percy Still, 19, Cadogan Gardens, London, S.W.

REVIEWS.

Single-phase Railways. By Edwin Austin. London: Constable & Co., Ltd. Price 21s. net.

This book consists of descriptions of complete railways or portions thereof which have previously appeared in the columns of *The Engineer*, considerably added to for publication in volume form. The author explains in his preface that, after delaying publication in order to make it cover everything, it became necessary to go to press without reference to the latest "split phase" developments. It can, therefore, be taken as being as nearly up-to-date as is practicable for a book describing the applications of a rapidly advancing art.

On the other hand, it is essentially descriptive and not theoretical. Although a good deal of information can be extracted on such matters as the characteristics of various motors, control systems, &c., involving more or less theoretical explanation, it is necessarily not in the consecutive form expected in a theoretical work.

The first chapter gives a *résumé* of the case for single-phase equipment of railways, pointing out particularly that the system lends itself to unlimited extension, whilst the low-tension direct-current system does not, and that though the direct-current system may be more suitable for suburban services, the inconvenience of working two systems is in favour of the one which can be extended. On the matter of overhead *versus* third rail equipment, it is remarked that the cost of the former has been considerably over-estimated by some advocates of the latter, that overhead equipment has been built at so low a cost as £800 per mile, that the high-tension direct-current system has to use overhead equipment, that the true criterion is relative total operating costs, and that every case should be decided on its merits. This is the true gospel, but its application is at present somewhat difficult owing to the paucity of data which can be fairly compared. It is quite on the cards that the controversy may be settled by delevopments permitting a combination of alternating-current transmission and distribution with continuous-current motor equipments, a combination of the strong points of both systems.

Very complete descriptions are given of the two English examples, the London, Brighton & South Coast suburban lines and Midland Heysham, Morecambe and Lancaster lines, with both of which our interested readers will be familiar. The illustrations of the Brighton work are particularly full, and include the profiles of the lines and a complete diagram of the distribution system, including the boosters used to keep the drop in the rails within the 20 volts allowed by the Board of Trade. Tests show that with the boosters out of operation 84 per cent. of the current returns by the rails and uninsulated outers of the feeders, but with the boosters in circuit nearly the whole current returns by the insulated return feeders.

The description of the Midland Railway work is less detailed, but the light, economical character of the overhead work is well brought out, as well as the ingenious trolley insulating devices.

A whole chapter is devoted to the electrified lines of the Midi Railway in France, notable as obtaining their power supply from Pyrenean waterfalls. Here, again, the overhead work is of a simple character, but of varying design on different sections, as at least four different contractors have had a share in the work and have each introduced their own material. It seems to have been the policy of the Midi Co. to divide the early work between different firms, as they have done the same thing in respect to locomotives, no doubt with the object of finding out by experience the most suitable equipment in each branch for guidance in future developments. There is, therefore, the interesting feature of illustrated descriptions of locomotives built by the French Thomson-Houston, Westinghouse, Constructions Electriques du Nord et de l'Est, Brown-Boveri, and A.E.G. Companies, all to the railway company's performance specification, and all differing in the ways the requirements are met. Regenerative braking was one of the requirements, important because the lines have considerable gradients, and the description includes a discussion of regenerative braking of an illuminating character. It suggests that this action is easier of attainment with single-phase than with continuous-current equipment. It may be said generally that with continuous current "it is not done," despite persistent and gallant attempts extending over nearly the whole history period of electric traction. There have, however, been recent important developments on American direct-current railways. The trolley wire on these lines is supplied at 12,000 volts 16⅔ cycles.

Chapter IV is occupied with descriptions of four German lines: The Blankenese-Hamburg-Ohlsdorf, Dessau-Bitterfeld, Murnau-Oberammergau, and the Mitterwald Railways. The second-named of these lines is remarkable for the size and power of the locomotives employed, and also for the elaborate design of the overhead contact system. The overhead supporting structures on the Blankenese line show much variety of contrivance to suit varying and difficult conditions. Both lines belong to the Prussian State Railways. The Murnau-Oberammergau line is notable for a gradient between three and four miles in length, with a general rise of nearly 3 per cent. The overhead work is of a much simpler character than on the State Railways before-mentioned.

The Mitterwald line is not exclusively German, as it extends into the Austrian Tyrol to Innsbruck. It is a characteristic mountain railway, with numerous tunnels, viaducts, and bridges, and some severe gradients. It was built for electrical working, and it is reckoned that about 2½ miles length was saved in the most difficult section by the use of steeper gradients than are permissible for steam traction. This saving in construction amounts to more than the total cost of the electrical equipment; an example worthy of note for future mountain railway propositions.

Chapter V is entirely occupied with a description of another mountain line, the St. Polten-Mariazell Railway, entirely in Austria, and also possessing a large number of tunnels, viaducts, and bridges. The gauge is only 0.76 m., say 2 ft. 6 in. It was built for steam working, but the capacity of the line so worked soon proved to be unequal to the traffic demands upon it.

Chapter VI describes four Swiss lines, of which the last, the Lötschberg-Simplon, is by far the most important in many respects. There are, however, some points worth notice in the equipment of the smaller concerns. The Martigny-Orsières line employs Déri repulsion motors, in which the reversal and torque and speed regulation are obtained by shifting a pair of auxiliary brushes, each connected to one of the fixed brushes. The electrical functions of the controller are limited to switching on and off the motor stator current. Everything else is done by the mechanical shifting of the brushes. The simplicity of this control gear is in striking contrast with the complexity of most of the alternative arrangements for series and composite series-repulsion motors, and as it is definitely stated that the starting torque, efficiency, and power factor of the motors compare favourably with those of series motors, the question arises, but is not answered in the book under notice, why has not the Déri system superseded all other single-phase traction motors. The claims are perhaps overstated.

The Lötschberg-Simplon Railway forms part of the international route from France through Berne and the Simplon Tunnel to Milan; it, therefore, has to carry trains of the heaviest character. The physical characteristics of the line are severe, including steep gradients, sharp and almost continuous curves, and long tunnels. The summit tunnel—Lötschberg—is 14¼ kilometres (say, 8¾ miles) in length, and on the northern approach there is a remarkable double loop shaped like an attenuated figure 8, of which much is in tunnel and little straight. The conditions are, therefore, exacting. For the purpose of local traffic, motor-cars are used. For the through traffic locomotives of 2,000 H.P. were first adopted, followed later by locomotives of 2,500 H.P. The former were driven by two motors, each carried on a six-wheeled bogie with coupled axles. The first reduction gear consists of a three-row Citroen pinion and gear wheel. This gearing permits the use of higher speed and lighter motors for the power than direct coupling.

The new locomotives of 2,500 H.P. exhibit considerable departures in design from the earlier ones. They also have two motors, but these are placed in the centre of the locomotive body, and drive the five coupled axles through two jack-shafts. The total weight is 107 tons, the weight on the driving-wheels 78.2 tons, the tractive force at the wheel rims 13½ tons at a speed of 50 km. (say, 31 miles) per hour. The maximum speed is 75 km. (say, 47 miles) per hour, and they can haul a train weighing 310 tons up a grade of 2.7 per cent. These locomotives, therefore, compare with all but the heaviest of European steam locomotives, and are probably the most powerful electric locomotives yet put into European service. The control arrangement presents some interesting features. The controllers are fixed immediately above the transformers with the secondary tappings connected directly to the contact fingers. The controller drums are driven by a pawl and ratchet gear actuated by a motor. The direction of rotation is controlled by a pair of electromagnets which lift one or other pawl out of gear. By actuating these magnets, therefore, the driver permits the continuously-running motor to turn the controller drum in either direction, or to leave it stationary. For dealing with very large currents, in this instance up to 3,000 amperes, at 400 volts, it is claimed that this direct action is more satisfactory and simpler than con-

tactor control. There are, of course, blow-out devices, and the usual series-parallel connections are available, both for the transformers and the motors. The supply on this line is at 15,000 volts, 25 cycles. The reader will not find any information about the difficulties with insulation which are said to have been experienced in the tunnels of this line. The overhead work is on the Siemens-Schuckert system.

Descriptions of the Rotterdam-Scheveningen Railway, a Siemens-Schuckert line (where the original three-phase scheme was altered to single-phase after the generating plant was far advanced, necessitating some ingenious adaptations resulting in the eventual supply of two phases to different line sections), and of two Norwegian lines occupy Chapters VII and VIII. The most interesting point in the latter is the description of telephone disturbances on neighbouring lines due to a large high-frequency harmonic in the generator voltage wave. This trouble was substantially overcome by connecting a tuned resonance shunt across the terminals, forming a virtual short circuit for the high-frequency current. This current proved to be of small magnitude, and, therefore, insignificant as a loss.

The Swedish State Railways have determined to adopt 15-cycle, single-phase energy as the general electrification standard. The conditions in Sweden are dear coal, abundant water power, and, in general, sparse population and low traffic density. These are evidently conditions in which economical transmission of energy is a ruling consideration. The first line electrified, described in Chapter IX, is that between Kiruna and Riksgränsen, only about eight miles in length, but wholly within the Arctic Circle, and the most northerly line in the world. It is mainly used for iron ore carrying, and, as in other mountainous mining districts, electrification has greatly increased the carrying capacity. The limits of steam traction had been reached. The practical and financial results are shown to be quite satisfactory.

The Panna single-phase line described in Chapter X is of somewhat special interest, because a portion of it is really a town tramway, and the remainder a roadside light railway. The tramway portion is worked at 400 volts and the railway part at 4,000 volts. The facility afforded by the single-phase system of working at the two voltages seems to have largely determined the choice, but the lines extend in two directions to about 15 miles from the power house, so that transmission and distribution economies were not negligible.

Chapter XI, the last, and nearly the longest, is wholly given up to descriptions of six American railways, commencing with the New York, New Haven & Hartford. This American work has been very fully discussed and described in the technical Press of both hemispheres. The problems offered by the New York, New Haven & Hartford line were particularly difficult at the time, including the requirement of running through from New York on 12 miles of direct-current track. The magnitude of the work done, between 500 and 600 miles of track, at an expense of £3,000,000, and the claims for lower capital expenditure and higher all-day efficiency put forward by the engineers, together with a large amount of experimental work of which many results have been freely published, tend to make this the typical single-phase main line, and the centre of controversy. It is, therefore, well that Mr. Austin has made his description full, and has been able to illustrate it lavishly. It is at least possible that this particular line will considerably modify its present system of operation before long, so that the record noticed may have historical value as showing a step in evolution towards settled practice.

The electrification of the Hoosac Tunnel, nearly five miles long, presented the difficulties usually found in adapting overhead work to a tunnel originally built for steam traction. How these were overcome is shown in detail, and as the working pressure is 11,000 volts the precedent is valuable. The insulators in use in the tunnel are two in series, each nominally capable of carrying 150,000 volts, so the factor of safety is large. It is noted that travelling in the tunnel is now quite a pleasure in hot weather, and that the tunnel is divided into three block sections with automatic signalling, so that its traffic capacity is trebled. The trains, with their steam locomotives complete, are hauled through the tunnel by the electric locomotives. This particular case is, therefore, an example of electrifying a tunnel section on which steam working is specially handicapped. The construction work was by no means easy. During steam working it was found that men could only work two hours per day in the tunnel, and were often rendered unconscious by the engine fumes. To assist matters during the electrification, traffic was carried on by oil-burning locomotives, which were also used on the two construction trains, each of which included a dining car! and compartments for the men to retreat to during the passage of steam trains, furnished with compressed air stores to keep out the smoke.

The St. Clair tunnel, on the Grand Trunk, between Michigan and Ontario, is another example of a difficult tunnel electrified to increase its traffic capacity. The approach gradients of 1 in 50 added to the difficulties of steam working. This particular tunnel is a "tube" of cast-iron segments 20 ft. in diameter. The pressure used is 3,300 volts. Although the tunnel is damp, no insulation troubles have been met with.

In concluding this notice, special praise must be given to the illustrations, especially the numerous diagrams of connections and line drawings of details, which are generally clear and satisfactory. If some of the connection diagrams require some puzzling out, that is due to the intricacies of the subject, and is in most cases eased by the textual descriptions. The lettering and figuring of these diagrams is clear, though sometimes minute enough to require a lens for easy reading. There is, of course, a large number of process block illustrations, but whilst these are not of so much technical value as the line drawings, they are of more illustrative value than is sometimes the case, and they add to the appearance, being generally excellently reproduced.—H. M. S.

Principles of Direct-Current Machines. By A. S. Langsdorf. London: Hill Publishing Co. Price 12s. 6d. net.

The author's preface states that "this book has been prepared with the object of placing before junior and senior students of electrical engineering a reasonably complete treatment of the fundamental principles that underlie the design and operation of all types of direct-current machinery."

The first chapter consists of 42 pages on general laws and definitions. The matter is well chosen and presented in an exceptionally clear manner. The methods of the calculus are freely used here, and, in fact, throughout the book, but a decided effort has been made to give prominence to the physical concepts of the various equations. Chapter II discusses the dynamo, the treatment being on orthodox lines and quite praiseworthy.

Armature windings are next dealt with. A full derivation of the rules covering armature windings (following Arnold) is included in addition to the usual description of typical windings. Chapter IV is devoted to the magnetisation curve and to magnetic leakage. The treatment of the saturation curve of machines is modern, the correction for the pole arc and slots due to Carter being given.

The complex subject of armature reaction next receives attention. The effect of fractional pitch armature windings and other refinements are much more thoroughly treated than usual.

Chapters VI and VII are occupied with the discussion of the characteristics of generators and motors. They include a considerable amount of new material, the treatment being largely graphical. The three-dimensional diagram is used for depicting the mutual relationships among the several variables. Several of the constructions are the same as are given in Arnold's "Die Gleichstrommaschine."

In Chapter VIII is developed a much more extensive treatment of the subject of commutation than has been heretofore easily accessible to students of the type for whom the book is intended. The treatment appears to be based very largely on Arnold's work, and on articles in the New York *Electrical World*. A good deal of advanced mathematical analysis is necessary before a student can read this chapter with advantage; in fact, this chapter is above the heads of the vast majority of ordinary students in technical colleges.

Efficiency, rating, and heating of direct-current machinery are next discussed on standard lines. The usual empirical curves for iron losses, &c., are included. The book concludes with a lengthy chapter on boosters, balancers, and train-lighting systems.

There can be little doubt that the author has succeeded in his purpose as set out in the extract from his preface above. The ground covered is comprehensive and the treatment thorough and rigorous. It should be distinctly understood that a competent knowledge of mathematics is necessary for the successful use of the book. The volume is well bound, the type very clear, and, as things are nowadays, it is worth its price.—H. G. S.

IMPORT TRADE OF CHINA.

The Chinese Imperial Maritime Customs have just issued an additional volume giving the countries of origin of the principal imports into China during 1912-14. The following figures, showing the value of imports in 1913 and 1914 of goods of interest to the electrical engineering industry, have been extracted from this new volume, and the increases and decreases shown. It is to be noted that the average value of the Haikwan Tael in 1913 was 3s. 0¼d., and in 1914 2s. 8¾d.

	Hk. Tls. 1913.	Hk. Tls. 1914.		Hk. Tls. Inc. or dec.
Electrical materials and fittings.—				
From Great Britain ...	596,000	736,000	+	140,000
,, Hong-Kong ...	174,000	244,000	+	70,000
,, Germany	845,000	705,000	−	140,000
,, Belgium	71,000	71,000		—
,, Italy	36,000	30,000	−	6,000
,, Japan	393,000	688,000	+	295,000
,, United States ...	179,000	135,000	−	44,000
,, Other countries ...	113,000	154,000	+	41,000
Total	2,407,000*	2,763,000†	+	356,000

* Includes 85,000 Hk. Tls. re-exported.

† Includes 57,000 Hk. Tls. re-exported.

	Hk. Tls. 1913.	Hk. Tls. 1914.	Hk. Tls. Inc. or dec.
Copper wire.—			
From Great Britain ...	21,000	7,000	– 14,000
,, Germany	17,000	29,000	+ 12,000
,, Belgium	2,000	1,500	– 500
,, Japan	137,000	143,000	+ 6,000
,, Other countries ...	12,000	6,500	– 5,500
Total	189,000*	187,000*	– 2,000
* Includes about 5,000 Hk. Tls. re-exported.			
Copper, bars, rods, sheets, plates, and nails.—			
From Great Britain ...	12,000	12,000	—
,, India	5,000	3,000	– 2,000
,, Germany	14,000	4,000	– 10,000
,, Belgium	1,000	13,000	+ 12,000
,, Japan	199,000	542,000	+ 343,000
,, Other countries ...	27,000	11,000	– 16,000
Total	258,000	585,000	+ 327,000
Aluminium, manufactures of.—			
From Great Britain ...	2,000	2,500	+ 500
,, Germany	35,000	5,000	– 30,000
,, Belgium	1,000	1,500	+ 500
,, Russia	2,000	2,000	—
,, Japan	21,000	22,000	+ 1,000
,, Other countries ...	4,000	2,000	– 2,000
Total	65,000	35,000	– 30,000
Rails.—			
From Great Britain ...	3,500	3,500	—
,, Germany	66,000	22,000	– 44,000
,, Belgium	247,000	196,000	– 51,000
,, Russia	216,000	42,000	– 174,000
,, Japan	17,000	39,000	+ 22,000
,, United States ...	372,000	394,000	+ 22,000
,, Other countries ...	500	17,500	+ 17,000
Total	922,000*	714,000†	– 208,000
* Includes 26,000 Hk. Tls. re-exported.			
† Includes 160,000 Hk. Tls. re-exported.			
Asbestos.—			
From Great Britain ...	26,000	24,000	– 2,000
,, Germany	6,000	8,000	+ 2,000
,, Belgium	4,000	16,000	+ 12,000
,, Russia	4,000	16,000	+ 12,000
,, Japan	14,000	19,000	+ 5,000
,, Other countries ...	10,000	9,000	– 1,000
Total	64,000	92,000	+ 28,000
Machine belting.—			
From Great Britain ...	140,000	144,000	+ 4,000
,, Germany	31,000	31,000	—
,, Belgium	1,000	7,000	+ 6,000
,, France	9,000	500	– 8,500
,, Russia	10,000	16,000	+ 6,000
,, Japan	58,000	57,000	– 1,000
,, Other countries ...	19,000	30,500	+ 11,500
Total	268,000	286,000*	+ 18,000
* Includes 8,000 Hk. Tls. re-exported.			
India-rubber and gutta-percha manufactures.—			
From Great Britain ...	58,000	40,000	– 18,000
,, Germany	27,000	9,000	– 18,000
,, France	30,000	14,000	– 16,000
,, Russia	223,000	186,000	– 37,000
,, Japan	36,000	47,000	+ 11,000
,, Other countries ...	44,000	34,000	– 10,000
Total*	418,000	330,000	– 88,000
* Includes 58,000 Hk. Tls. re-exported.			
Telegraph and telephone materials.—			
From Hong-Kong ...	41,000	97,000	+ 56,000
,, Great Britain ...	261,000	59,000	– 202,000
,, Germany	225,000	224,000	– 1,000
,, Belgium	90,000	56,000	– 34,000
,, Japan	89,000	78,000	– 11,000
,, Other countries ...	13,000	53,000	+ 40,000
Total*	719,000	567,000	– 152,000
* Includes 32,000 Hk. Tls. re-exported.			
Railway carriages and wagons, including tramcars.—			
From Great Britain ...	83,000	603,000	+ 520,000
,, Germany	370,000	75,000	– 295,000
,, Belgium	558,000	1,470,000	+ 912,000
,, Russia	85,000	28,000	– 57,000
,, United States ...	33,000	86,000	+ 53,000
,, Other countries ...	98,000	78,000	– 20,000
Total	1,227,000*	2,340,000†	+ 1,113
* Includes 33,000 Hk. Tls. re-exported.			
† Includes 117,000 Hk. Tls. re-exported.			

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,479. "Electric furnaces for smelting and refining metals." J. S. Romanes. March 27th.

4,509. "Contact breakers for magneto-electric generators." V. Dupont and M. P. P. Syndicate. March 27th.

4,518. "Receiving instrument for wireless signalling." A. Artom. March 27th.

4,558. "Electric discharge apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 28th.

4,561. "Electric dynamos." T. L. R. Cooper. March 28th.

4,575. "Holders for incandescent electric lamps." J. Salt. March 28th.

4,596. "Portable electric battery lamps." H. F. Joel. March 29th.

4,606. "Ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 29th.

4,619. "Electric light watchstand." S. Worrall & J. H. Worrall, Son and Co. March 29th.

4,620. "Spark plugs." J. W. Baird. March 29th.

4,625. "Electric torches." A. A. King. March 29th.

4,629. "Electric ignition of explosives." R. Miller. March 29th.

4,661. "Bomb or explosive shell, and apparatus for lowering, sustaining, and exploding same by electricity from aeroplane, &c." S. H. Sturtevant. March 30th.

4,674. "Light telegraphy." J. A. Fleming. March 30th.

4,683. "Electric switches." W. T. Henley's Telegraph Works Co. and E. E. Judge. March 30th.

4,688. "Electrical systems for engines." W. A. Chryst & C. F. Kettering. March 30th. (U.S.A., July 16th, 1914.)

4,691. "Apparatus for guiding trolley pulley of electric cars and locomotives to overhead wire." W. G. Jenkins. March 30th.

4,697. "Electric oscillators." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 30th.

4,699. "Switching apparatus for inter-connecting telephone lines by electro-mechanically controlled switches." F. Aldendorff. March 30th.

4,703. "Circuit-breaking apparatus for electrical heaters." J. E. Harvey. March 30th. (U.S.A., April 3rd, 1915.)

4,713. "Electric cut-outs." F. D'Alquen. March 30th.

4,733. "Alternating-current systems." A. E. McColl. March 31st.

4,752. "Combined electric lampholders and switches." W. Donovan. March 31st.

4,771. "Machine tools." British Thomson-Houston Co. (General Electric Co.). March 31st.

4,775. "Carbon brushes for electrical machines." J. E. Grant & Morgan Crucible Co. March 31st.

4,780. "Process for electrolytic deposition of zinc on metallic surfaces." P. Marino. March 31st.

4,788. "Dynamo-electric machines." H. Chitty. March 31st.

4,816. "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 1st.

4,827. "Automatic cut-in and cut-out for electric circuits." A. P. Turnbull. April 1st.

PUBLISHED SPECIFICATIONS.

1914.

13,951. Electric Furnaces for Metallurgical or other purposes. H. Nathusius & Westdeutsche-Thomasphosphat-Werke Ges. June 9th.

24,056. Apparatus for Detecting the Presence of Electric Conductors. A. W. Sharman. December 15th. (Cognate application, 8,961/15.)

24,170. Electric Heat Radiators. A. F. Berry. December 16th.

24,644. Sparking Plugs. R. O. C. Hurst & F. B. Mills. December 24th.

1915.

247. Magneto-electric Generators for Lighting, Charging, and Ignition purposes. C. H. Melsome-Smith. January 7th. (July 1st, 1915.)

3,841. Electric Step-by-step Signalling Apparatus. Sterling Telephone and Electric Co., F. G. Bell, & H. W. Barclay. March 10th.

3,856. Apparatus for Measuring Electric Current. Landis & Gyr Akt. Ges March 10th. (March 10th, 1914.)

3,882. Magnetos. G. A. Lister, E. A. Watson & M-L. Magneto Syndicate, Ltd. March 11th.

3,932. Method of and apparatus for Winding the Armatures of Electric Machines. G. Schöngut. March 12th. (March 13th, 1914.)

3,949. Incandescent Electric Lamps. C. H. Harrison. March 12th.

3,950. Wireless Receiving Systems. L. de Forest & C. V. Logwood. March 12th. (March 12th, 1914.)

4,144. Oil-immersed Electric Switches or Circuit Breakers. F. B. Holt and H. Smith. March 16th.

4,229. Electrical Coils and Methods of Winding same. H. Wade (J. R. Leeson). March 17th.

4,401. Electric Rotary Converters. M. Walker. March 20th.

4,432. Protective Devices for Alternating-current Systems. British Thomson-Houston Co. & E. B. Wedmore. March 20th.

5,017. Automatic Telegraph Transmitters. A. C. Baronio & K. L. Wood. March 31st.

5,628. Electric Lamp Lock. W. G. Rudd. April 14th.

6,723. Equalising Field Windings for Multi-polar Dynamo-electric Machines. E. Rosenberg. May 5th.

7,492. Electric Soldering Irons. M. J. Railing & G. H. Ide. May 19th.

8,358. Field Telephone and Telegraph Apparatus. H. North. June 5th.

9,428. X-ray Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 28th.

10,803. Vacuum Drying and Impregnating Device, more especially suitable for Treatment of the Coils of Electrical Machinery and Apparatus. Emil Haefeley et Cie. July 26th. (July 24th, 1914.)

13,754. Stationary Electrode for Igniters. Standard Co. September 27th. (September 26th, 1914.)

15,989. Terminal for Electric Switches, Couplings, and the like. G. Markt. November 12th

17,690. Electrically-controlled Electric Circuit Breakers. British Westinghouse Electric & Manufacturing Co. December 17th. (December 29th, 1914.)

1916.

2,956. Dry Battery. F. P. Baumann. February 16th, 1915. (Patent No. 100,086.)